BIOMECHANICS BASED MOTOR LEARNING

PHT PROJECT®

MODULO 1

A cura di Andrea Fusco

MOTOR LEARNING

- Motor learning is a generic term comprising a huge diversity of phenomena
- It can be applied to any movement made by human subjects in different tasks or activities

Consequently, It is of enormous practical relevance to several different fields:

- Sport
- Arts (Music, Dance, etc.)
- Driving
- Rehabilitation

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Aim and Definition

- The essence of motor learning is producing more effective

movements (improving motor skill, i.e. smoothness or accuracy of movements)

- Is a relatively permanent change in behavior resulting from experience and practice.
- Is not directly observable: its changes are inferred from performance changes.
- Is necessary for complex movements (such as speaking, playing piano, sports, etc.) but it is also important for
- calibrating simple movements (parameters of the body and environment change over time)

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AIM AND DEFINITION

- Rehabilitation is based on the assumption that practice or training leads to improvement of skills after neural damage
- Learning-related improvement is mediated by changes in neural plasticity
- Rehabilitation for patients with neurological disorders is fundamentally a process of relearning how to move in order to carry out their needs successfully

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AIM AND DEFINITION

Motor learning can be defined as

any experience- dependent improvement in performance

✓Movement goal selection

✓ Action selection

✓Action execution

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MOTOR LEARNING AIMS

- improving skill
- maintaining consistent performance overtime

in spite of

- Human changes: growth, fatigue, injury or damages
- Environmental changes

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MOTOR CONTROL DEFINITIONS

1. Skill acquisition

The ability to

- ✓ rapidly identify an appropriate movement goal in a particular task context
- ✓ select the correct action in relation to environmental stimuli and the current state of the body and
- ✓ execute that action with accuracy and precision

2. Skill maintenance

The ability to maintain performance levels of existing skills under changing conditions

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Learning Modalities

Motor adaptation: a particular type of behavioral change that involves adjusting how an already well-practiced action is executed to maintain performance in response to a change in the environment or the body

- Selecting an alternative well-practiced action
- Modifying how the current action is executed

i.e. Sequence learning, *De novo* motor learning

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Learning Modalities

- Sequence learning: learning the proper order of a sequence of discrete actions such that each is selected rapidly and executed

accurately (i.e. goal selection and action selection).

- *De novo* motor learning: a new motor controller (some network or process that generates motor output) is developed

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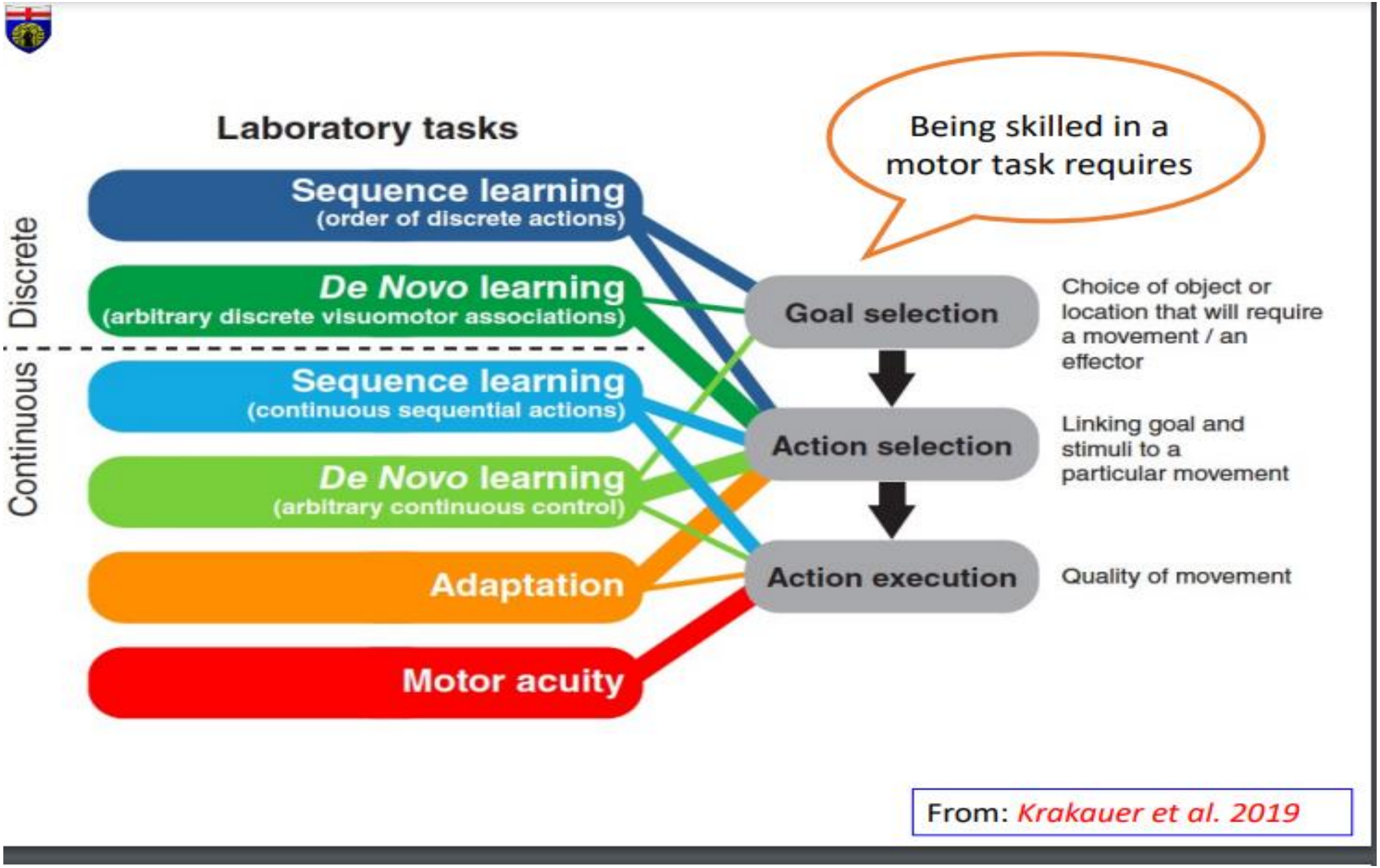

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Learning (adaptation) components

A first component that:

- learns quickly
- is **poorly** retained
- is **explicit** and expressible only at ***high reaction times***
- is temporally ***labile***
- is driven by reward and task success

A second component that:

- learns slowly
- is retained **well**
- is **implicit** and expressible at ***low reaction times***
- is temporally ***stable***
- is driven by sensoryprediction error

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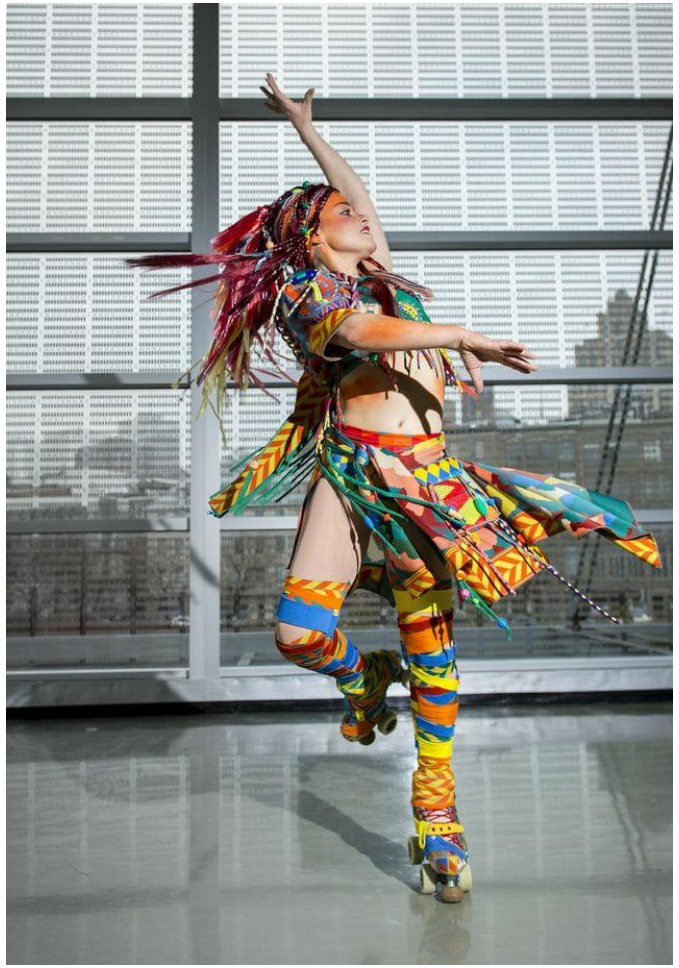
Motor Adaptation

Capacity to compensate for environmental changes

- Visuo-spatial Rotations
- Force Perturbation



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Evidenze alla base del PHT_Project

- il muscolo eroga maggiore forza quando in condizione di normotensione
- il vantaggio meccanico del sistema scheletrico è maggiore impiegando coppie di forze a partenza prossimale (momento vs. braccio)
- Il controllo motorio deve riguardare le azioni agonista e antagonista
- Il reclutamento nell'ambito delle catene cinetiche deve seguire la corretta sequenza temporale e spaziale

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