

Voluntary Movement I.

Psychophysical principles & Neural control of reaching and grasping

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Introduction

- Reflex and voluntary movements are sensorimotor transformations.
 - Feedforward vs. feedback control.
- Reflex control differs from voluntary control
 - Spatial organization of reflexes reflects hard-wired connections vs. behavioral demands and context: decisions. Voluntary movements are organized to be appropriate to address behavioral goal: kinematic vs. dynamic transformations - internal models.
 - Reflex latency & duration reflect mainly fixed neuromuscular constraints: conduction, transmission, contraction. These, also influence timing of voluntary movement, but information processing and accuracy constraints are the critical reaction time and movement duration.
 - Neural organization of voluntary movements is highly dependent on learning and plasticity. Adaptability is critical over long term.

Today

1. Voluntary movements require decisions and information processing: Latency and duration:

- Reaction time.
- Parallel processing.
- Speed-accuracy tradeoffs.

2. Sensorimotor transformations in reaching and grasping.

- Kinematics: visuomotor transformations. Movement vectors
- Dynamics: internal models.
- Role of vision and proprioception in feedback and feedforward control

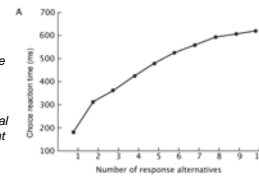
3. Organization of motor cortical areas for reaching and grasping

- Multiple motor areas
- Somatotopic organization
- Redundancy

Latency or “Reaction time” depends on decision

Reaction time paradigm

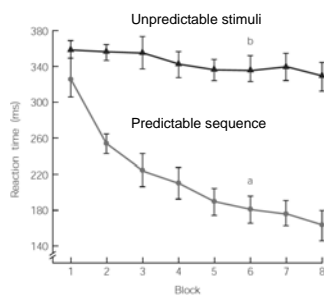
- Warning -> cue = go signal
- Simple RT: *single or predictable cue* Subject knows what response to make in advance
- Choice: *multiple unpredictable cues (e.g. colors, symbols, spatial locations) each requiring different responses.*



Stage theory of reaction time



“Reaction time” depends on practice and learning



Response features can be processed in parallel

