

Fundamentals of Effective Therapeutic Exercise: Part Two

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MEDBRIDGE

Layers of Facilitation

Patterns of movement and normal timing

- **Body position**
- Primitive reflexes/righting and equilibrium reactions
- Manual contacts
- Stretch
- Vision
- Verbal Cues
- Resistance
- Traction/approximation

Chapter One

Body Position

Body Position: Therapist

- The patient will move toward where the therapist's body is
- Make sure you position yourself in the proper place

In the diagonal



Body Position: Patient

- Tactile input of patient position
 - Prone
 - Supine
 - Sidelying
- Gravity: assist, resist
- Positioning to increase/decrease challenge

Examples of Patient Treatment Positions



Examples of Patient Treatment Positions (cont.)



Examples of Patient Treatment Positions (cont.)



Chapter Two

Primitive Reflexes/ Righting and Equilibrium Reactions

Layers of Facilitation

Patterns of movement and normal timing

- Normal timing
- Body position
- **Primitive reflexes/righting and equilibrium reactions**
- Manual contacts
- Stretch
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Primitive Reflexes/Righting and Equilibrium Reactions

Primitive Reflexes

- TLR
- ATNR/ STNR
- + Supporting



Primitive Reflexes/Righting and Equilibrium Reactions (cont.)

- Early motor development dominated by reflex activity
- Mature motor behavior reinforced by reflexes
- During pathology influence may increase



Bruijn SM1, et al. "Are effects of the symmetric and asymmetric tonic neck reflexes still visible In healthy adults?" *Neurosci Lett.* 2013 Nov 27;556:89-92. doi: 10.1016/j.neulet.2013.10.028. Epub 2013 Oct 21

Righting and Equilibrium Reactions



- Righting reactions
 - Midbrain
- Equilibrium reactions
 - Cortex
- Protective extension and staggering

Chapter Three

Manual Contacts

Layers of Facilitation

Patterns of movement and normal timing

- Normal timing
- Body position
- Primitive reflexes/righting and equilibrium reactions
- **Manual contacts**
- Stretch
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Manual Contacts

Can facilitate or inhibit

- Firm pressure over agonist facilitates agonist
- Firm pressure over antagonist inhibits agonist
 - Stimulates Sensory Receptors: Merkles' disks
 - Creates a static or holding response

Hoogenbloom, BJ, 2009

Manual Contacts (cont.)

- **Light touch**
 - Stimulates free nerve endings
 - Facilitates movement
 - Anywhere on dermatome or muscle facilitates¹
- **“Strength is decreased following light touch of skin over antagonistic muscle”: scratch test²**

1. Hoogenbloom, BJ, 2009

2. Nicholas, et. al. 1980

Demonstration of Manual Contact

- Biceps and triceps manual contact demo two minutes
- Extend and flex positions

Demonstration of Manual Contact (cont.)

Light tough demo two minutes

Manual Contacts

Neutral surfaces

- Crown of head
- Heel
- Side of arm and leg

Hagbarth, 1952

Manual Contacts (cont.)

Treatment implications



Manual contacts on antagonist



Manual contacts on agonist

Correct Manual Contacts to Facilitate Rolling



Manual Contacts

- Guides patient's movements
- Stimulates synergists
- In presence of pain
 - Place contacts away from painful area
 - Touch agonist and antagonist simultaneously
 - Place contacts on trunk for proximal stability and limb movement



Summary of Manual Contacts

Whenever possible

- Pressure over skin/muscles/tendons/joints responsible for movement
- In line with direction of resistance
- Apply pressure opposite to direction of movement

Chapter Four

Stretch

Layers of Facilitation

Patterns of movement and normal timing

- Normal timing
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- Primitive reflexes/righting and equilibrium reactions
- Manual contacts
- **Stretch**
- Vision
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Why Stretch?

- Initiates movement
- Increases EMG activity and strength of muscle contraction with simultaneous inhibition of antagonists¹
- Influences direction of movement
- Fosters quicker response in weak muscles
- Contraindications
 - **Pain**
 - **Instability**

1. Manning et al, 2011

Kinds of Stretch

1. Position patient in the lengthened range
2. Quick stretch
3. Repeated stretch
 - The muscle itself has elastic properties that respond to stretch

Edman, Elzinga, and Noble, 1978

Position the Patient in the Lengthened Range

Position patient in the lengthened range



Edman, Elzinga, and Noble, 1978

Stretch

- **Quick Stretch (spinal reflex)**
 - Elongate muscles in a pattern to “tension” point
 - Tension in all components of pattern
 - Superimpose a quick, gentle elongation further into
 - 3-D direction of pattern
- **Rotation** elongates muscle fibers in a pattern

Yavuz, S, 2014; Manning, CD, 2011

Demo Video

Repeated Stretch

Repeat stretch throughout range as needed when you feel strength decreasing

- Apply at the beginning of or during range
- Also apply by tapping muscle belly or tendon
- “Brushing” in the direction of the movement

Yavuz, S, 2014; Manning, CD, 2011

Demo Video

Chapter Five

Vision

Layers of Facilitation

Patterns of movement and normal timing

- Normal timing
- Body position
- Primitive reflexes/righting and equilibrium reactions
- Manual contacts
- Stretch
- **Vision**
- Verbal Cues
- Resistance
- Traction/approximation

Vision

- Leads and corrects movement
- Influences head, neck and trunk motion
 - Activity: look over left shoulder, look at wall behind you

Vision (cont.)

- Increases force of muscle contraction
- Improves speed and accuracy¹
- Visual targets to improve motor performance²

1. Connely, Goodale, 1999

2. Land, M., 2006

Internal vs. External Focus

- Motor learning enhanced by directing performers' attention to effects of movements (external focus) rather than to body movements producing effects (internal focus)
- Motor skills degraded if learner pays too much attention to their performance (tennis example)

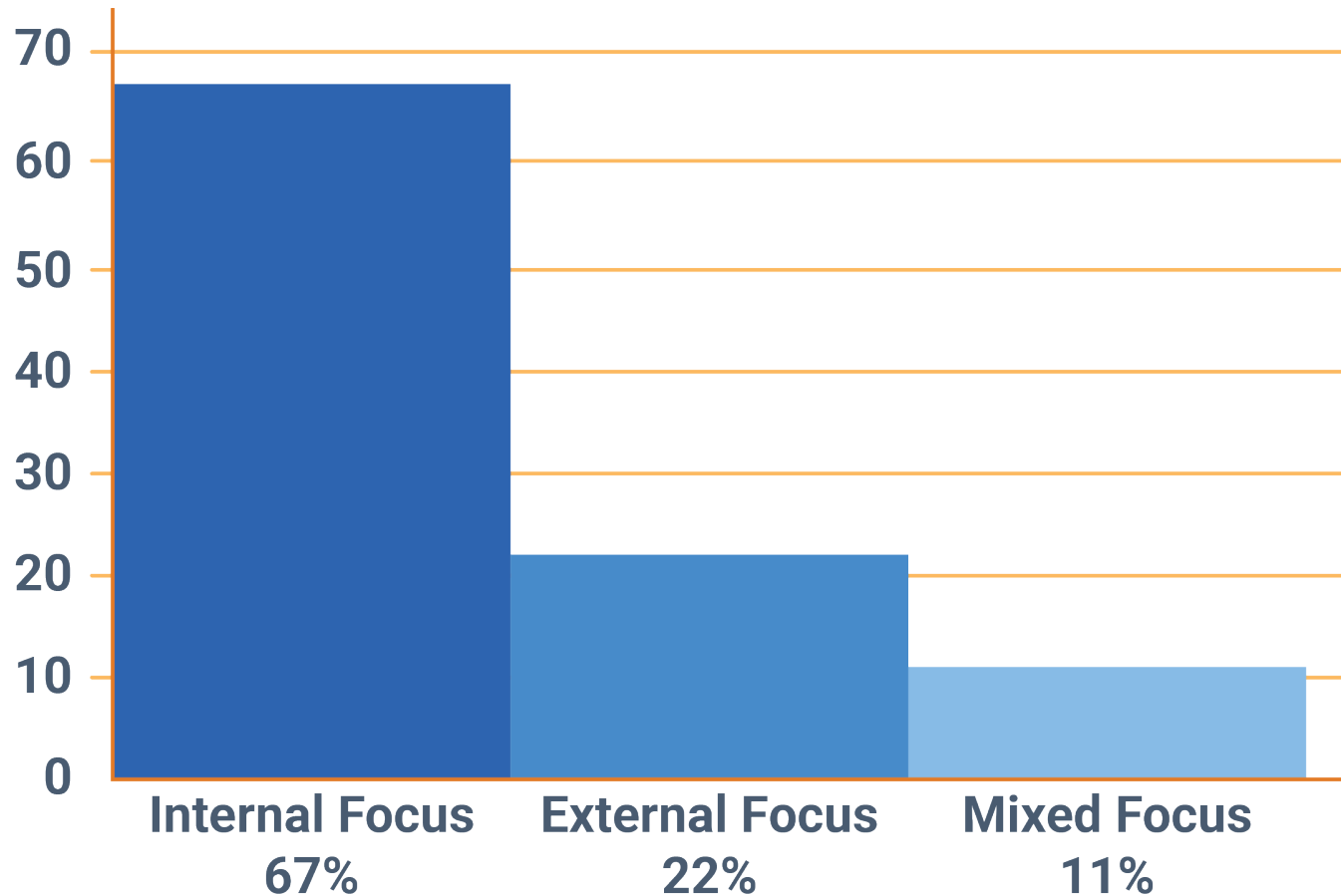
Internal and External Focus During Gait

Therapists used

- Verbal commands frequently (every fourteen seconds to be exact)
- Clear trend toward internal focus

Johnson, L et al. Internal and External Focus of Attention During Gait Re-education, Physical Therapy, July 2013

Internal and External Focus During Gait (cont.)



Johnson, L et al. Internal and External Focus of Attention During Gait Re-education, Physical Therapy, July 2013

Internal and External Focus: Verbal Cues Given by Therapists

- “When you stand up get your knees straight” (internal focus)
 - Think about touching the top of your head to the ceiling to get your knees straight (EF)
- “Lean far forward when you stand” (IF)
 - Think about getting your knees in front of your toes when you stand” (external focus)
- “Bend your knee more while stepping up”
 - (IF)
- “Lift your toes high to get your foot on stool”
 - (Mixed Focus)
- “Take longer steps” (IF)
 - Step over this line or step into the hula hop (EF)

Johnson, L et al. Internal and External Focus of Attention During Gait Re-education, Physical Therapy, July 2013

Vision

“An external focus of attention enhances golf shot accuracy in beginners and experts”



Wulf and Jung Su, 2007

Use of Visual Cues



- External cue block off
- External focus

Demo Video

Use of Visual Cues (cont.)

Chapter Six

Verbal Cues

Verbal Commands

- Simple, crisp, clear commands enhance sub-cortical input: more functional
- Hold when tell patient to hold
- Allow movement when you say move
- Timing important
 - Just prior to stretch
- Volume
 - Loud: stronger contraction
 - Soft and calm: relaxation, pain control

Bruck C, 2014

Verbal Command Study

Too much verbal input can actually degrade performance, especially individuals with brain injury

Do Explicit Instructions Improve Implicit Learning for Patients with Stroke?

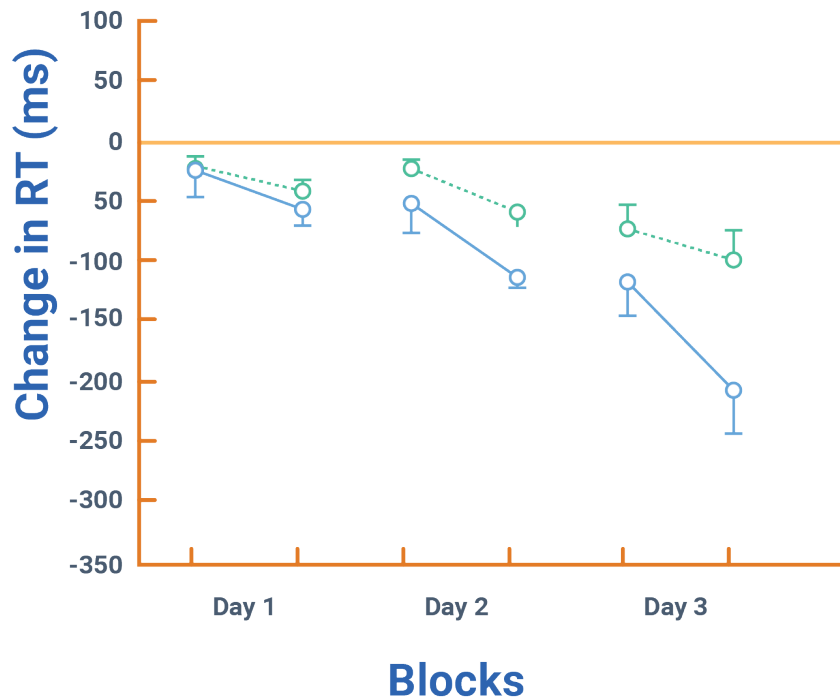
- Impact of explicit information on implicit motor-sequence learning following middle cerebral artery stroke¹
- Study design
 - Ten patients with stroke and ten without assigned to an EI or a no-EI group
 - Response time (RT) for a serial reaction time task was measured

1. Boyd and Winstein, 2003

Results at Post Test

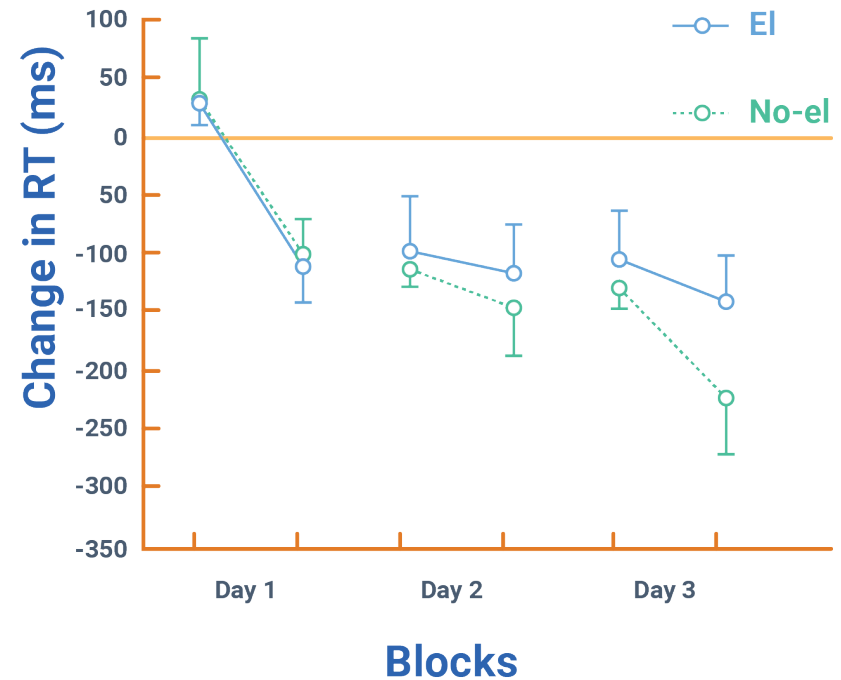
Down is better

Control Subjects



Control subjects get better progress with explicit information

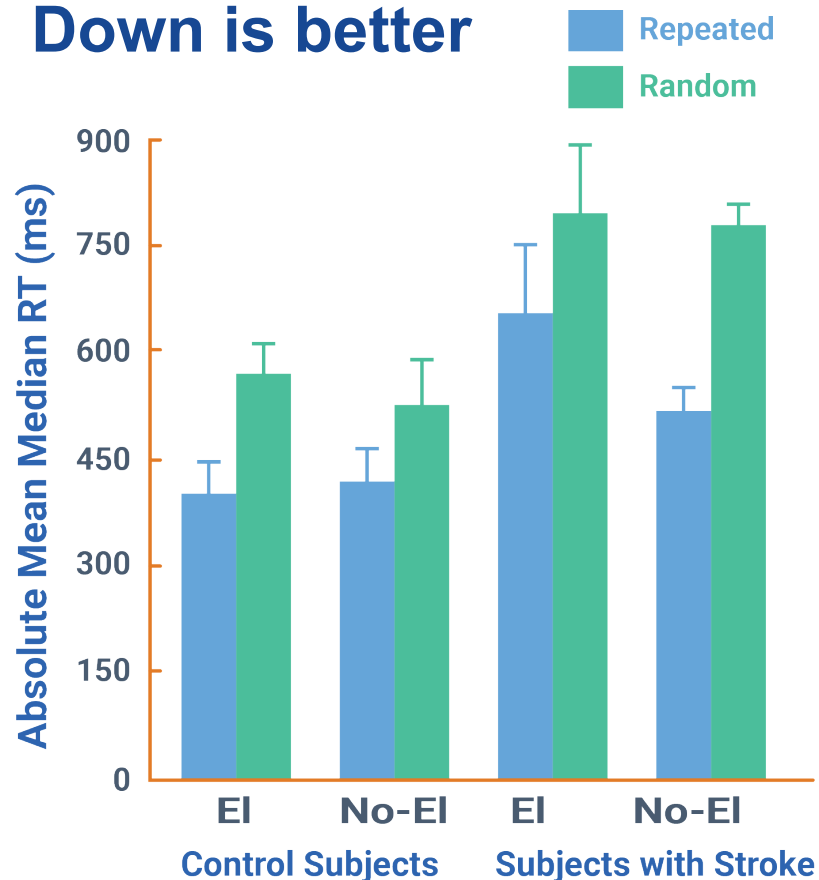
Control Subjects



Subjects with stroke get better progress with no explicit information

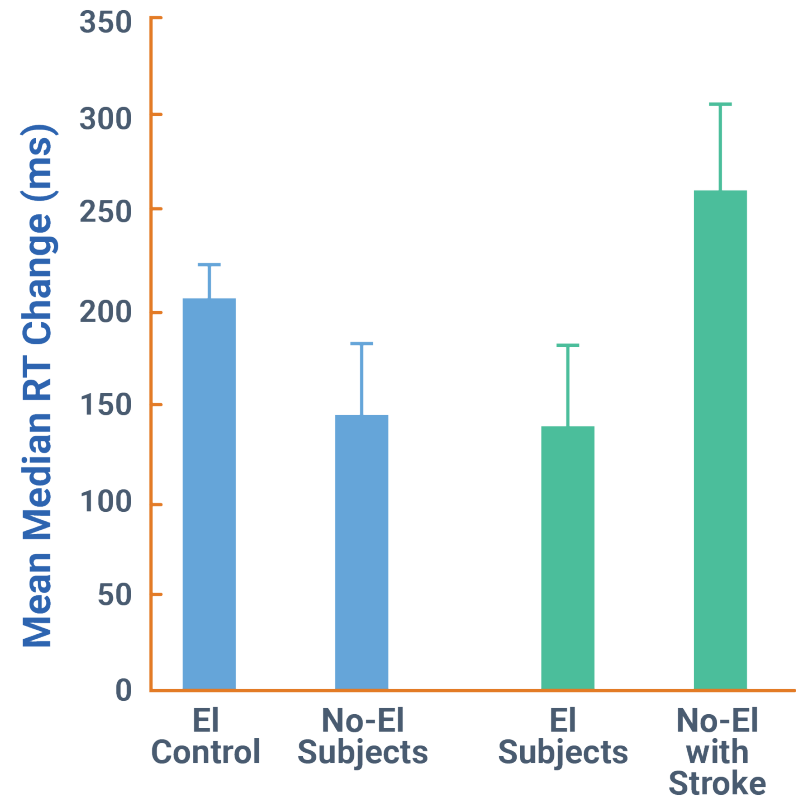
Results of Retention Tests

Down is better



The performance of those with stroke was always slower than that of controls

Up is better



Explicit information interfered with learning in participants with stroke

Study Findings

- EI did not benefit task learning: degraded both performance and learning
- Explicit instructions used to focus attention rather than provide information

Other Study findings

- The same results were found after basal ganglia stroke
- Explicit information benefits implicit learning in healthy participants
- Basal ganglia damage disrupts capacity for explicit information to influence implicit motor plan
- Explicit info is less helpful than discovering a solution

Boyd and Winstein, 2005

Verbal Commands

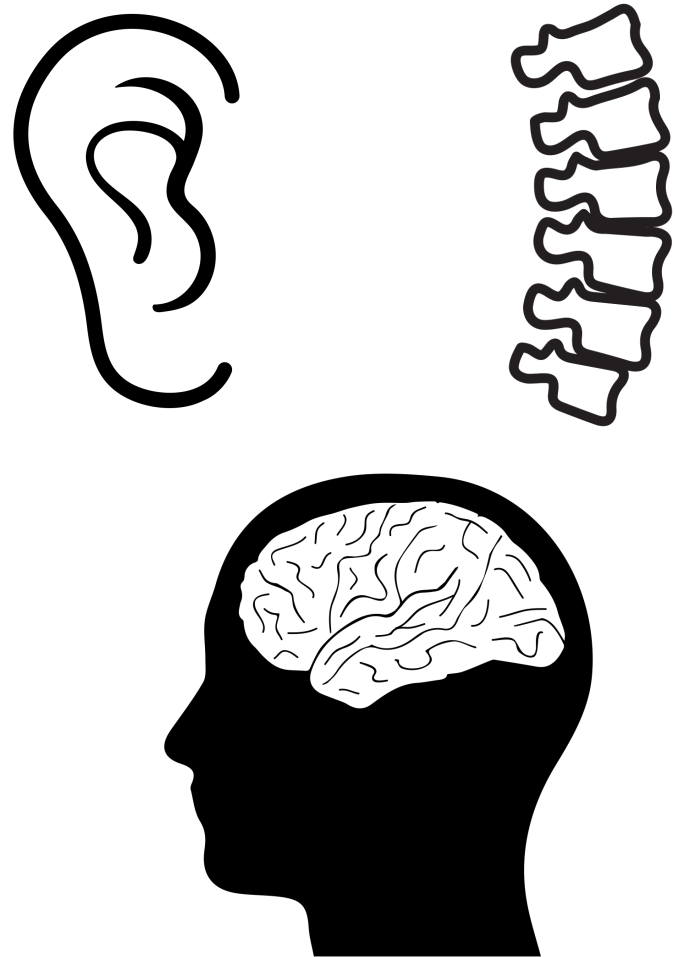
- Help identify relationship of body to environment
- Improves voluntary motor control and motor planning
- Facilitate arousal
- Instructs

Bruck C, 2014

Auditory Input

Auditory spinal reflex

- Directly to the cord for a startle type response
- To the cortex and back down for an interpretation of “push”



Bruck C, 2014

Chapter Seven

Resistance

Layers of Facilitation

Patterns of movement and normal timing

- Normal timing
- Body position
- Primitive reflexes/righting and equilibrium reactions
- Manual contacts
- Stretch
- Vision
- Verbal Cues
- **Resistance**
- Traction/approximation

Resistance

- Nobel Laureate Sir Charles Sherrington
- **Sherrington emphasized** that the neuromuscular system does not work in isolation but rather in a unified manner
- **Developed concepts of**
 - Irradiation
 - Successive induction
 - Reciprocal innervation

Molnar, Z., Brown R., 2010

Resistance (cont.)

Used to

- Evaluate
- Facilitate contraction
- Increase control of movement
- Teach, increase awareness of movement
- Increase strength

Brody L, 2011

Appropriate Resistance

- Patient can reach goal in a smooth and coordinated fashion
- May be guided or assisted movement
 - Demo example
- Maximal effort yields increased strength
 - Avoid Valsalva
 - Avoid pain

Gellhorn, et al.

Resistance is Applied to

- **Isotonic Muscle Contractions**
 - Concentric: lifting glass, walking uphill
 - Eccentric: lowering glass, walking downhill
 - Allow patient to move
- **Isometric Muscle Contractions**
 - Stabilizing
 - Allow patient to hold

O'Sullivan SB, 2013

Use Resistance For

- Irradiation
- Reciprocal inhibition
- Successive induction
- Maximal resistance/maximal relaxation

Sherrington C, 1947; Molnar Z, 2010; Crone C, 1993

Resistance: Irradiation

- Spreading and increasing strength of a response
- Occurs when the number or strength of stimuli is increased
- May be excitation or inhibition
- Good place to use indirect approach
- Contralateral effects: acute care

Munn et al., 2004

Demo Video

Resistance: Irradiation

Resistance: Reciprocal Innervation

Sometimes seen in the literature as “reciprocal innervation”

- Excitation of agonist, inhibition of antagonist
- Necessary for coordinated movement

Crone, C., 1993

Demo Video

Hamstring relaxation with contraction of the
quadriceps

Resistance: Successive induction

- Basis for Reversal of Movement
- Contraction of antagonist is followed by increased excitation of agonist

Demo Video

Successive Induction Video

Use Resistance For

- Maximal contraction yields maximal relaxation
- Basis of relaxation techniques
 - Contract-relax
 - Hold-relax

Traction/Approximation

- Directed toward joint receptors
- Traction
 - Promotes movement
 - Facilitates flexors
- Approximation
 - Increases muscular response
 - Promotes stability
 - Often used with weight bearing postures and with extension

Chapter Eight

Summary

Layers of Facilitation

Patterns of movement and normal timing

- Normal timing
- Body position
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With Treatment

Goal is for individual to successfully complete task without facilitation

- Use a patient's strengths to enhance movement/function
 - e.g. irradiation
- Add layers of facilitation as needed to guide client's learning, facilitate/strengthen normal movement patterns, and increase independent function
- Resistance can be used to evaluate, facilitate, and improve strength

Summary

- In order to be able to analyze patient's deficits, we need to know what normal movement is
 - Must be able to function in all planes of movement
 - Proceeds from distal to proximal
 - Must develop stability and mobility
 - Normal movement has combinations of head and neck, trunk and extremities. The extremities move in symmetrical, asymmetrical, ipsilateral, contralateral, reciprocal combinations.
- Patient's response will be enhanced with the following
 - Correct body position of the therapist as they approach the patient
 - Use of manual contacts to facilitate or inhibit the movement
 - Utilizing reflexes to improve patient response

Summary (cont.)

- Appropriate use of the three types of stretch to facilitate the muscle response
- Use of visual cues and an external focus during treatment
- Providing simple and concise verbal cues
 - Too much verbal input can degrade performance

How Layers of Facilitation are Used in Patient Care of Older Adult with Neuro Deficits

- Various neuro deficits: stroke, pd, ms, tbi
 - Use layers of facilitation while doing
 - Mat interventions
 - Postural transitions
 - Balance
 - Gait
- Thank you for taking the first two fundamentals courses, I look forward to seeing you in the intervention courses