PNF Basic Principles and Procedures for Facilitation

Contents

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The basic facilitation principles and procedures, when used correctly, provide tools for the therapist to use in helping the patient to gain efficient motor function and increased motor control.

Therapeutic Goals

The basic facilitation procedures can be used to:

- Increase the patient's ability to move
- Increase the patient's ability to remain stable
- Guide the motion by proper grips and appropriate resistance
- Help the patient achieve coordinated motion through timing
- Increase the patient's stamina and avoid fatigue

The individual facilitation procedures are not used as isolated applications; rather, they overlap and complement each other in their effectiveness. For example, **resistance** is necessary to make the **response to a stretch** effective (Gellhorn 1949). The effect of resistance changes with the alignment of the therapist's body and the direction of the manual contact. The timing of these procedures is important to get an optimal response from the patient. For example, a preparatory verbal command comes before the stretch reflex. Changing of the manual contacts should be timed to cue the patient for a change in the direction of motion.

We can use these basic procedures to treat patients with **any diagnosis or condition**, although a patient's condition may rule out the use of some of them. The therapist should avoid causing or increasing pain. Pain is an inhibitor of effective and coordinated muscular performance and it can be a sign of potential harm (Hislop 1960; Fisher 1967). Other contraindications are mainly common sense: for example, not using approximation on an extremity with an unhealed fracture. In the presence of unstable joints, the therapist should be extremely cautious and deliberate when using traction or the stretch reflex.

The IPNFA made a distinction between "basic principles" and "procedures" (IPNFA Instructor Day, Tokyo 2005 and Ljubljana 2006).

Basic principles:

Exteroceptive stimuli:

- Tactile stimulation (► Sect. 2.3)
- Verbal stimulation (► Sect. 2.4)
- Visual stimulation (► Sect. 2.6)

Proprioceptive stimuli:

- Resistance (► Sect. 2.1)
- Traction (► Sect. 2.7)
- Approximation (► Sect. 2.7)
- Stretch (► Sect. 2.8)

Procedures are:

- Reinforcement/Summation
- Patterns (► Chap. 5)
- Timing (► Sect. 2.9)
- Body mechanics and body position (► Sect. 2.4)
- Irradiation (► Sect. 2.2)

The **basic principles** and **procedures** for facilitation are:

- **Resistance**:
  Used to aid muscle contraction.
  Used to increase motor control and motor learning.
  Used to increase strength.
- **Irradiation and reinforcement**: used to spread the response to stimulation.
- **Manual contact**: used to increase power and guide motion or movement with proper grip and pressure.
- **Body position and body mechanics**: proper body mechanics and proper positioning of the therapist enable him/her to provide a specific and well-aimed guidance to better control motion, movement, or stability.
- **Auditory stimulation (commands)**: use of words and the appropriate vocal volume to direct the patient.
- **Visual stimulation**: use of vision to guide motion and increase force. The visual feedback simplifies motion. This is because the patient tracks and controls

Table 2.1 Basic principles of facilitation

Treatment	Definition	Main goals, applications
Optimal resistance	The intensity of resistance depends on the patient's capabilities and on the treatment goal	Promotes muscle contractility. Improves motor learning. Improves perception and control of movement. Muscle strengthening
Irradiation Reinforcement	The spread of the response of nerve impulses of a given stimulation. Increase stimulation by the addition of a new stimulus	Facilitates muscle contractions (including the effect on the contralateral side)
Tactile stimulus (manual contact)	Stimulation of sensitive skin receptors and other pressure receptors	Improves muscle activity. When used on the trunk, promotes trunk stability. Provides confidence and security. Promotes tactile and kinesthetic perception
Body position and body mechanics	Therapist: position in the direction of movement. Patient: correct starting position	Enables the patient to work in an economical and goal-oriented way without hindering movement. Allows the therapist to use his body weight optimally to avoid fatigue
Verbal stimulation	Tells the patient what to do and when to do it	Guides the start of movement. Affects the strength of the muscle contractions or of relaxation. Promotes the attentiveness of the patient. Helps the patient to learn a functional activity
Visual stimulation	The patient follows and controls his movements by having eye contact	Stimulates muscle activity in terms of coordination, strength, and stability. Informs the therapist on the appropriateness of the applied stimulus; whether it was too intensive or caused pain. Informs the therapist about the pain intensity and compatibility of the applied stimuli. Provides an avenue of communication and helps to achieve a cooperative interaction
Traction	An extension of the trunk or a limb performed by the therapist	Facilitates motion, especially pulling and antigravity motions. Aids in elongation of muscle tissue when using the stretch reflex. Helps to prepare for the stretch reflex and stretch stimulus. Provides relief of joint pain
Approximation	Compression of the trunk or an extremity	Promotes stabilization. Facilitates weight bearing and the contraction of antigravity muscle. Facilitates upright reactions. Used to resist some component of motion
Stretch stimulus	Occurs when a muscle is elongated under optimal tension	Facilitates muscle contractions. Facilitates contraction of associated synergistic muscles
Timing	Sequencing of motions	
Normal timing	Normal timing provides continuous, coordinated motion, from distal to proximal	Improves coordination of normal movement
Timing for emphasis	Changing the normal sequencing of motions to emphasize a particular muscle or a desired activity	Redirects energy from the stronger to the weaker muscles
PNF patterns	Synergistic combinations of three-dimensional muscle contractions	Facilitates and increases muscular response

movement and position with his eyes. By having eye contact, the therapist and the patient receive feedback about the performed movement.
- **Traction or approximation**: the elongation or compression of the limbs and trunk to facilitate motion and stability.
- **Stretch**: the use of muscle elongation and the stretch reflex to facilitate contraction and decrease muscle fatigue.
- **Timing**: promote normal timing and increase muscle contraction with proper inputs and through "timing for emphasis."
- **Patterns**: synergistic mass movements, components of functional normal motion.

The therapist can combine these basic procedures to get a maximal response from the patient. Each of the basic procedures will be explained in detail. Their definition, application, and treatment goals will be summarized.

2.1 Optimal Resistance

Therapeutic Goals

Resistance is used in treatment to:
- Facilitate the ability of the muscle to contract.
- Increase motor control and improve motor learning.
- Help the patient to gain an awareness of motion and its direction.
- Increase strength.
- Help the patient to relax the muscle (reciprocal inhibition).

Most of the PNF techniques evolved from knowledge of the effects of resistance.

The intensity of resistance provided during an activity is dependent on the capabilities of the patient as well as on the goal of the activity. This we call **optimal resistance**.

▶ Example

- The resistance for learning a functional activity like standing up from a sitting position or going down the stairs is mostly a guidance resistance to teach the patients to control these activities.
- Resistance for irradiation or strengthening of muscles is intensive.◀

Gellhorn showed that when a muscle contraction is resisted, that muscle's response to cortical stimulation increases. The active muscle tension produced by resistance is the **most effective** proprioceptive facilitation. The magnitude of that facilitation is related directly to the amount of resistance (Gellhorn 1949; Loofbourrow and Gellhorn 1948a). Proprioceptive reflexes from contracting muscles increase the response of synergistic muscles[1] at the same joint and associated synergists at neighboring joints. This facilitation can spread from proximal to distal and from distal to proximal. Antagonists of the facilitated muscles are usually inhibited. If the muscle activity in the agonists becomes intense, there may be activity in the antagonistic muscle groups as well (co-contraction). (Gellhorn 1947; Loofbourrow and Gellhorn 1948a).

How we give resistance depends on the kind of muscle contraction being resisted (◘ Fig. 2.1).

Definition

We define the **types of muscle contraction** as follows (International PNF Association, unpublished handout; Hedin-Andèn 2002):
- **Isotonic** (dynamic): the intent of the patient is to produce motion.
  - Concentric: shortening of the agonist produces motion.
  - Eccentric: an outside force, gravity or resistance, produces the motion. The motion is restrained by the controlled lengthening of the agonist.

1 Synergists are muscles that act with other muscles to produce coordinated motion.

Fig. 2.1 Types of muscle contraction of the patient. **a** Isotonic concentric: movement into a shortened range; the force or resistance provided by the patient is stronger. **b** Isotonic eccentric: the force or resistance provided by the therapist is stronger; movement into the lengthened range. **c** Stabilizing isometric. The patient tries to move but is prevented by the therapist or another outside force; the forces exerted by both are the same. **d** Isometric (static): the intent of both the patient and the therapist is that no motion occurs; the forces exerted by both are the same

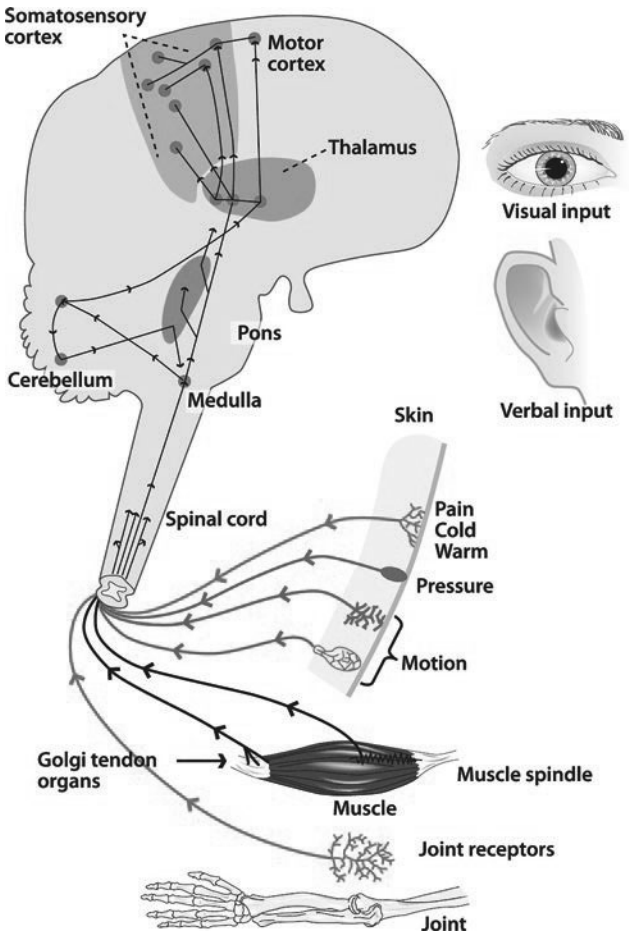

Fig. 2.1 **e** PNF receptors. (Modified from Klein-Vogelbach 2000)

  - Stabilizing isometric: the intent of the patient is motion; the motion is prevented by an outside force (usually resistance).
- **Isometric** (static): the intent of both the patient and the therapist is that no motion occurs.

The resistance to concentric or eccentric muscle contractions should be adjusted so that motion can occur in a smooth and coordinated manner. The antagonists of the facilitated muscles allow a coordinated activity and therefore they are sufficiently inhibited to allow that activity. Resistance to a stabilizing contraction must be controlled to maintain the stabilized position. When resisting an isometric contraction, the resistance should be increased and decreased gradually so that no motion occurs.

It is important that the resistance does not cause pain, unwanted fatigue, or unwanted irradiation in the wrong direction or into an undesired part of the body. Both the therapist and the patient should avoid breath holding. Timed and controlled inhalations and exhalations can increase the patient's strength and active range of motion.

2.2 Irradiation and Reinforcement

Properly applied resistance results in irradiation and reinforcement.

Irradiation is defined as the spread of the response of nerve impulses of a given stimulation.

This response can be seen as increased facilitation (contraction) or inhibition (relaxation) in the synergistic muscles and patterns of movement. The response increases as the stimuli increase in intensity or duration (Sherrington 1947). Kabat (1961) wrote that it is resistance to motion that produces irradiation, and the spread of the muscular activity will occur in specific patterns. These patterns can vary from patient to patient.

Definition

Reinforcement. Reinforce as defined in Webster's Ninth New Collegiate Dictionary, is "to strengthen by fresh addition, make stronger."
The therapist directs the reinforcement of the weaker muscles by the amount of resistance given to the strong muscles.

Increasing the amount of resistance will increase the amount and extent of the muscular response. Changing the movement that is resisted or the position of the patient will also change the results. The therapist adjusts the amount of resistance and type of muscle contraction to suit (1) the condition of the patient, for example, muscle strength, coordination, muscle tone, pain, different body sizes, and (2) the goal of the treatment. To increase the irradiation and reinforcement it is not limited to use only resistance. The therapist can also use other stimuli such as approximation, verbal stimulation, stretch, and manual contact. By using these stimuli the temporal as well the spatial summation can increase.

Because each patient reacts differently, it is not possible to give general instructions on how much resistance to give or which movements to resist. By assessing the results of the treatment, the therapist can determine the best uses of resistance, irradiation, and reinforcement.

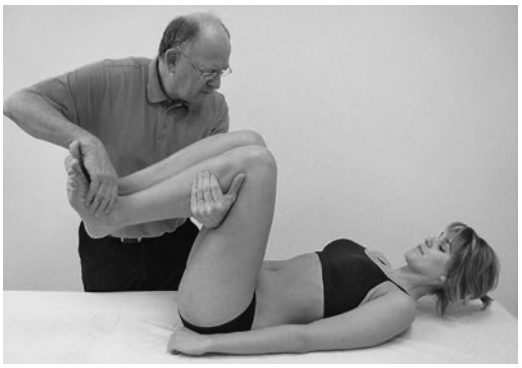

Fig. 2.2 Irradiation into the trunk flexor muscles when doing bilateral leg patterns

▶ Example

Examples of the use of resistance in patient treatment:

- Resist muscle contractions in a sound limb to produce contraction of the muscles in the immobilized contralateral limb.
- Resist hip flexion to cause contraction of the trunk flexor muscles (Fig. 2.2).
- Resist supination of the forearm to facilitate contraction of the external rotators of that shoulder.
- Resist hip flexion with adduction and external rotation to facilitate the ipsilateral dorsiflexor muscles to contract with inversion (Fig. 2.3).
- Resist neck flexion to stimulate trunk and hip flexion. Resist neck extension to stimulate trunk and hip extension.◀

2.3 Tactile Stimulus (Manual Contact)

Therapeutic Goals

- Pressure on a muscle to aid that muscle's ability to contract.
- To give the patient security and confidence.
- To promote tactile and kinesthetic perception.
- Pressure that is opposite to the direction of motion on any point of a moving limb stimulates the synergistic limb muscles to reinforce the movement.

Fig. 2.3 **a** Irradiation to dorsiflexion and inversion with the leg pattern flexion–adduction–external rotation. **b** Irradiation for mid-stance support to the ipsilateral leg with the arm pattern into flexion–adduction–external rotation

- Contact on the patient's trunk to help the limb motion indirectly by promoting trunk stability.

The therapist's grip stimulates the patient's **skin receptors** and other pressure receptors. This contact gives the patient information about the proper direction of motion. The therapist's hand should be placed to apply the pressure opposite to the direction of motion. The sides of the arm or leg are considered neutral surfaces and may be held.

The tactile stimulation from the precise application of the therapist's hands has the following effects on the stimulated structures:

- The ability of a muscle contraction is increased when a pressure is exerted on it.
- The synergists are facilitated when a muscle is given resistance against its movement. This leads to reinforcement in regard to the motor control.
- Tactile stimuli promote the tactile and kinesthetic perception during the performance of movement.

To control movement and resist rotation the therapist uses a **lumbrical grip** (Fig. 2.4). In this grip the pressure comes from flexion at the metacarpophalangeal joints, allowing the therapist's fingers to conform to the body part. The lumbrical grip gives the therapist good control of the three-dimensional motion without causing the patient pain due to squeezing or putting too much pressure on bony body parts (Fig. 2.5). Using the lumbrical grip allows the therapist to apply traction, which makes a movement easier. Traction is also a condition for the application of stretch.

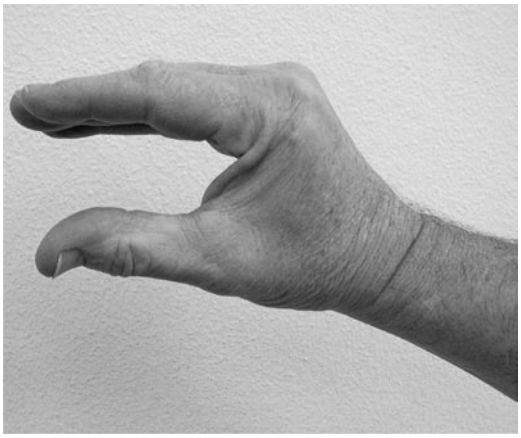

Fig. 2.4 The lumbrical grip

If the patient has no or decreased control over an eccentric muscle activity, for example, going from a standing to a sitting position, the therapist can give the patient the kinesthetic information for this goal-oriented movement by putting his hands on the top of the iliac crest and applying pressure downward and backward. If some muscles show too little synergistic activity, we can facilitate the desired muscle activity by giving a tactile stimulus. The therapist should give tactile stimuli when and where the patient needs

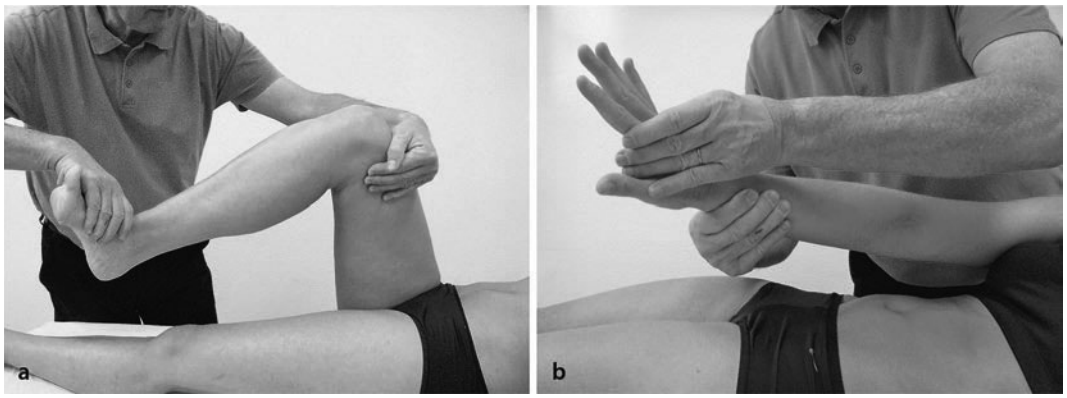

Fig. 2.5 Lumbrical grips. **a** For the leg pattern flexion–adduction–external rotation. **b** For the arm pattern flexion–abduction–external rotation

it, but only for as long as the patient needs it to increase the patient's independence and promote motor learning. The goal is for the patient to be able to control the activity by himself/herself. Normally, the therapist has one hand distally and the other hand also distally or proximally when treating patients with extremity activities. If it is necessary to solve the patient's problem in another way, the therapist can change the normal grips.

2.4 Body Position and Body Mechanics

Proper Body Mechanics of the Therapist:
- Give the therapist effective control of the patient's motion.
- Facilitate control of the direction of the resistance.
- Enable the therapist to give resistance without provoking pain.
- Ensure that the therapist's movement will be ergonomic and aimed correctly.

Johnson and Saliba first developed the material on body position as presented here. They observed that more effective control of the patient's motion came when the therapist was in the line of the desired motion, as presented here. As the therapist shifted position, the direction of the resistance changed and the patient's movement changed with it. From this knowledge they developed the following guidelines for the therapist's body position (G. Johnson and V. Saliba, unpublished handout 1985):

- The therapist's body should be **in line** with the desired motion or force. To line up properly, the therapist's shoulders and pelvis face the direction of the motion. The arms and hands also line up with the motion. If the therapist cannot keep the proper body position, the hands and arms maintain alignment with the motion (Fig. 2.6).
- The resistance comes from the therapist's **body** whereas the hands and arms stay

Fig. 2.6 Positioning of the therapist's body for the leg pattern flexion–abduction–internal rotation

comparatively relaxed. By using body weight the therapist can give prolonged resistance without fatiguing. The relaxed hands allow the therapist to feel the patient's responses.

Not only are the body position and body mechanics of the therapist important but also the position in which the patient is treated. The treatment goal as well other factors influence this position. The functional activity the patient needs, muscle tone, muscle strength, pain, and stability of the patient and therapist are some of the factors that need to be considered when choosing the appropriate position in which to treat patients. The patient sits or lies comfortably and near the edge of the treatment table. The therapist stands by the patient's side, where he can offer the patient adequate security and stability (◘ Fig. 2.6).

Points to Remember

- An optimal body position and body mechanics from the therapist promote a smooth and ergonomic movement from the patient without having to give much resistance. By moving as much as possible in the diagonal direction, the therapist gives the patient nonverbal information regarding the desired movement.
- A good body position and movement of the therapist gives the patient a secure feeling.
- A good body position enables the therapist to use his body weight optimally to provide the resistance and to avoid fatiguing.

2.5 Verbal Stimulation (Commands)

Therapeutic Goals

- Guide the start of movement or the muscle contractions.
- Affect the strength of the resulting muscle contractions or affect relaxation.
- Give the patient corrections. Correct commands promote the attentiveness of the patient. A clear and precise verbal command, without unnecessary words, is helpful for the patient to learn a functional activity.

> The verbal command tells the patient what to do and when to do it.

The therapist must always bear in mind that the command is given to the patient, not to the body part being treated. Preparatory instructions need to be clear and concise, without unnecessary words. They may be combined with passive movement and visual control from the patient to teach the desired movement.

The **timing** of the command is important to coordinate the patient's reactions with the therapist's hands and resistance. It guides the start of movement and muscle contractions. It helps to give the patient corrections for motion or stability.

Timing of the command is also very important when using the **stretch reflex.** The initial command should come immediately before the stretch of the muscle chain to coordinate the patient's conscious effort with the **reflex response** (Evarts and Tannji 1974). The action command is repeated to urge greater effort or redirect the motion.

In reversal techniques, proper timing between verbal commands and muscle activity is important when we change the direction of the resistance. A preparatory command should be given with the therapist changing hand and an action command should be given with the therapist applying resistance in the new direction.

The **volume** with which the command is given can affect the strength of the resulting muscle contractions (Johansson et al. 1983). The therapist should give a louder command when a strong muscle contraction is desired