Principles of Neural Plasticity

Neuroplasticity: The brain's ability to form, recreate, or modify neural connections (synapses in the brain). This commonly occurs after learning, a new experience, or from an injury such as a stroke or brain injury.

Neuro=Relating to the brain
Plasticity=Ability to change or be modified

01 USE IT OR LOSE IT

Failure to drive specific brain functions can lead to functional degradation.

Neural pathways that are not actively used or stimulated for prolonged periods of time can break down.

- Example: Patients who have decreased upper extremity function post a brain injury, and do not use it on a daily basis can lead to decreased upper extremity neural pathways.

02 USE IT AND IMPROVE IT

Training that drives a specific brain function can lead to an improvement.

Neural pathways can be built through extended training and practice.

- Example: The use of constraint induced movement therapy (CIMT) can promote increased plasticity/motor recovery in the hemiplegic side-use the hemiplegic side and improve the hemiplegic side.

03 SPECIFICITY MATTERS

The nature of the training experience dictates the nature of the plasticity

Practice the specific task you want to improve/impact.

- Example: Task specific training that uses real objects in functional movement patterns (such as using a pen/pencil) that a patient would typically do (for writing) is ideal to facilitate specific training (i.e. hand writing).

04 REPETITION MATTERS

Induction of plasticity requires sufficient repetition

To promote neural pathways to develop or strengthen, it is important to perform activities repeatedly.

- Example: Using ones' affected UE throughout the day (not just in therapy sessions) for many activities allows for repetition and more practice.

05 INTENSITY MATTERS

Induction of plasticity requires sufficient training intensity.

To promote neural pathways to develop/strengthen, it is important to perform activities with a high dosage/intensity. This includes both the amount or difficulty level.

- Example: Use of task specific training (300 reps in 1 hour) can promote increased UE recovery. Such as practicing picking up a fork and bringing it to one's mouth (to promote self-feeding) many times (ie 100 times in ~20 minutes).

Created by Artemis Sefandonkis, OTR/L, OTD

References: Holleran et al., 2014; Kleim & Jones, 2008; Kwakkel, 2006; Puderbaugh & Emmady, 2022; Wang et al., 2013; Verma, 2023; Wolpaw, 2012.

Principles of Neural Plasticity Continued

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06 TIME MATTERS

Different forms of plasticity occur at different times during training

Time post incident matters, as there is typically an increased chance for plasticity to occur closer to the incident. A more ideal window of time for plasticity to occur.

- Example: The first 1-3 months (up to 1 year) post CVA tends to be when the most plasticity occurs.

07 SALIENCE MATTERS

The training experience must be sufficiently salient to induce plasticity

Tasks being performed should be of importance to the patient to promote increased plasticity

- Example: Keeping activities functional and important to the person, will help promote plasticity. For a patient who avidly made coffee, incorporating coffeemaking practice will increase the meaning and motivation to practice that task and help improve this meaningful pathway to the person.
- *Client-centered goal setting is key- you can use tools such as the COPM to help guide your plan of care.

08 AGE MATTERS

Training-induced plasticity occurs more readily in younger brains

The more plasticity typically occurs the younger someone is.

- Example: Younger brains are more responsive to cortical reorganization and older brains are less responsive to change.

09 TRANSFERENCE

Plasticity that occurs from one functional activity can transfer to other untrained task by activating nearby neural pathways.

The ability for one set of neural circuits to promote similar or subsequent pathways.

- *Transference can be enhanced with TMS, TCDS, eSTIM, and exercise.*

Example: Skill training with tasks involving fine motor control in the fingers can lead to improvement in nearby pathways for tasks that involve the entire hand.

10 INTERFERENCE

Plasticity in response to one experience can interfere with the acquisition of other behaviors.

Plasticity can be blocked from occurring.

- Example: Therapy that benefits one skill may impede another, such as with compensatory strategies; hemi-techniques can decrease the use of a hemiparetic limb decreasing re-learning.
- Example: When patients may not be able to get treatment right away, they may have developed compensatory behaviors, which may not be the best way to perform the task.

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