CLINICAL APPLICATIONS IN NEUROREHABILITATION WITH CHILDREN AND ADULTS:

BUILDING ON PRINCIPLES OF NEUROPLASTICITY

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NEUROREHABILITATION

Neurorehabilitation or 'cognitive remediation' typically includes strategies such as:

- Providing direct training to improve specific cognitive processes or skills/abilities,
- Working to maximize emotional and behavioural adjustment (e.g., metacognition, self-regulation),
- Providing compensatory mechanisms or teaching strategies to augment areas of weakness,
- Modifying the environment to eliminate or reduce the need for specific skills or abilities.

10 PRINCIPLES OF PLASTICITY KLEIM & JONES, 2008

Table 1. Principles of experience-dependent plasticity.

Principle	Description
1. Use It or Lose It	Failure to drive specific brain functions can lead to functional degradation.
2. Use It and Improve It	Training that drives a specific brain function can lead to an enhancement of that function.
3. Specificity	The nature of the training experience dictates the nature of the plasticity.
4. Repetition Matters	Induction of plasticity requires sufficient repetition.
5. Intensity Matters	Induction of plasticity requires sufficient training intensity.
6. Time Matters	Different forms of plasticity occur at different times during training.
7. Salience Matters	The training experience must be sufficiently salient to induce plasticity.
8. Age Matters	Training-induced plasticity occurs more readily in younger brains.
9. Transference	Plasticity in response to one training experience can enhance the acquisition of similar behaviors
10. Interference	Plasticity in response to one experience can interfere with the acquisition of other behaviors.

INTERACTIONS ABOUND

- The principles of neuroplasticity work in concert, not isolation
- Coupling principles (e.g., repetition with saliency) may maximize effects
- Plasticity within one set of neural circuits promotes concurrent or subsequent plasticity (e.g., training fine digit movement increases coriticospinal excitability)
- Coupling interventions with peripheral or central stimulation may be necessary to drive transference effects in to a functionally beneficial direction (e.g., exercise, arousal

Goals of Behavioral & Emotional Interventions

To develop self-regulatory capacities and increase insight and awareness (metacognition)

- Metacognitive strategies involve executive regulation processes directed at organizing ones behavior to complete a task
 - to allocate resources to achieving a goal,
 - to determine the order of steps to be taken to complete the goal, and
 - To self-monitor, regulate the intensity or the speed at which one should work towards the goal.
- Cognitive self-efficacy, beliefs about ones cognitive abilities predicts cognitive engagement and success in interventions

INTERVENTIONS TO IMPROVE BEHAVIORAL & EMOTIONAL SELF-REGULATION

Executive control interventions

· Goal management training

Metacognitive interventions

- · Cognitive self-efficacy training
- · CBT approaches
- · Self-Regulation scripts
- ALERT training

Mindfulness meditation approaches

EVIDENCE-BASED TREATMENTS: LINKS TO NEUROPLASTICITY?

Behavioral & Emotional interventions

Metacognitive approaches

Mindfulness

Cognitive Behavioral approaches

Systems/Process oriented interventions

Motor recovery

Attention/Working Memory Training

Compensatory interventions
Instructional strategies
Technology based compensatory tools

Goals of Process Specific Approaches

To directly impact specific processes

- Based on the notion that 'capacity' can be increased by exercising specific components of abilities
- Interventions are designed and believed to improve the underlying impaired process directly
- The change in underlying capacity is assumed to be secondary to neural plasticity and/or reorganization of neural systems as previously discussed – as such the principles of neural plasticity should guide the intervention

INTERVENTIONS TO INCREASE MOTOR FUNCTION

Constraint induced movement therapy (CIMT)

Background and theory

- · Based on primate studies of hemiplegic limb
- Intensive shaping and repeated practice using the affected (hemiplegic) limb
- Incorporates constraining the use of the unaffected limb for most waking hours over the period of treatment
- Associated with improvement in function of affected limb & change in brain activation (e.g. Taub, 2004)

INTERVENTIONS TO INCREASE MOTOR FUNCTION

Constraint induced movement therapy (CIMT)

- · Efficacy in adults
- · Evidence for neuroplastic changes in adults
- · Efficacy in children
- Evidence for neuroplastic changes in children

OTHER MOTOR FUNCTION INTERVENTIONS

Serial assessment of motor function after severe TBI using motor re-learning principles

Exercise approaches in FASD

INTERVENTIONS TO INCREASE ATTENTION & WORKING MEMORY

Background and Theory

- · Adopt a treatment model grounded in attention theory
- · Use therapy activities that are hierarchically organized
- · Provide sufficient repetition to re-establish skills
- Base treatment decisions on performance adapt the level of difficulty based on success
- Actively facilitate generalization to functional activities from the start
- Incorporate elements to increase cognitive self-efficacy (metacognition)

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INTERVENTIONS TO INCREASE ATTENTION & WORKING MEMORY

Attention & working memory training

- · Efficacy in adults
- · Evidence for neuroplastic changes in adults
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GOALS OF COMPENSATORY APPROACHES

To remove or reduce the need to rely on an impaired function or process

- Recognizes that some functions will not recover or will only recover partially
- Interventions are designed to increase function and relieve stress and anxiety associated with limitations
- Compensatory interventions may be integrated passively into the individual's routine or may be used and managed in a very active and interactive way
- Technology advances have dramatically influenced a range of compensatory devices and approaches

COMPENSATORY & TECHNOLOGY APPROACHES

- · Compensations for organizational/planning difficulties
- · Compensations for memory impairment
- · Applications for communication
- · Virtual reality interventions for improved movement

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