Agenda

What is Cognitive Rehabilitation?

Who Gets Cognitive Rehabilitation?

Where Does Cognitive Rehabilitation Take Place and Who are the Providers?

Cognitive Rehabilitation Strategies
What is Cognitive Rehabilitation?

Cognition:
“The mental action or process of acquiring knowledge and understanding through thought, experience, and the senses”

Encompasses:
- Knowledge
- Attention
- Memory
- Judgment
- Reasoning
- Comprehension
- Language

Human Cognition is:
- Conscious
- Unconscious
- Concrete
- Abstract
- Intuitive

Cognitive processes use existing knowledge and generate new knowledge
Cognitive Rehabilitation
Basics of Cognition

Mechanism of Cognition
- Formation of Connections between Neurons in the Brain
- Sending and Receiving of Signals between Connected Neurons

Any factor that interferes with these processes creates a Barrier to Cognition = “Cognitive Deficit”

Cognitive Rehabilitation: Brain Injury Interdisciplinary Special Interest Group (BI-ISIG)

“…a systematic, functionally oriented service of therapeutic cognitive activities, based on an assessment and understanding of the person’s brain-behavior deficits. Services are directed to achieve functional changes by (1) reinforcing, strengthening, or reestablishing previously learned patterns of behavior, or (2) establishing new patterns of cognitive activity or compensatory mechanisms for impaired neurological systems.”

(Harley, et al. 1992)
Cognitive Rehabilitation (according to one large insurance company)

An adjunctive treatment of cognitive deficits (e.g., attention, language, memory, reasoning, executive functions, problem solving, and visual processing) medically necessary when performed by a licensed health care professional acting within their scope of practice and all of the following are met:

1. Neuropsychological testing has been performed and neuropsychological results will be used in treatment-planning and directing rehabilitation strategies, and
2. The cognitive deficits have been acquired as a result of neurologic impairment due to moderate to severe traumatic brain injury, brain surgery, stroke, or encephalopathy, and
3. The member has been seen and evaluated by a neuropsychiatrist or neuropsychologist, and
4. The member is able to actively participate in a cognitive rehabilitation program (e.g., is not comatose or in a vegetative state); and
5. The member is expected to make significant cognitive improvement.

History of Cognitive Rehabilitation

WWI – advocates for solders with head injuries recommended both remediation and direct vocational training. Schools for German soldiers utilized psychological testing and measurement of concrete skills.

Functional skill building

WWII – increased interest in cognitive rehabilitation; including skill specific training and ability training in some instances. Focused on treatment of soldiers with brain injuries.

Alexander Luria – Theory of Functional Systems
   Strengthen skills and teach compensatory skills

Today – TBI patients and increased research
**Theoretical Considerations**

Physical Rehabilitation models

Deficit Driven theories

Cognitive Psychology

Research conundrums

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**Cognitive Deficits**

Durable Causes
- Brain Injury (stroke, TBI)*
- Neurological Disorders*
- Congenital Defects
- Psychiatric Disorders

Temporary Causes:
- Prescription Drugs
- Recreational Drugs
- Alcohol
- Nutritional Deficiency
- Dehydration

*C: Clinical

Cognitive Deficit:
“Any factor that acts as a barrier to the cognition process”
Cognitive Rehabilitation
Cognitive Deficits from Brain Trauma

<table>
<thead>
<tr>
<th>Attention</th>
<th>Memory</th>
<th>Executive Function</th>
<th>VisuoSpatial</th>
<th>Visual Field</th>
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<td>Alertness</td>
<td>Sustained Attention</td>
<td>Selective Attention</td>
<td>Divided Attention</td>
<td>Change of Focus</td>
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<td>~80%</td>
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<td>Hemi-Neglect</td>
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<td>Phonological Loop</td>
<td>Vis-Spat Sketchpad</td>
<td>Long-term</td>
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<tr>
<td>~65%</td>
<td>~75%</td>
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<td>Planning</td>
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<td>Inhibition</td>
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<td>Empathy</td>
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<td>Position</td>
<td>Orientation</td>
<td>Angles, Volumes</td>
<td>Depth Perception</td>
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<td>2D / 3D Rotation</td>
<td>Mental Imagery</td>
<td>Background</td>
<td>Separation</td>
<td>Face Recognition</td>
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<td>Hemianopia</td>
<td>Quadrantanopia</td>
<td>Scotoma</td>
<td>Midline Shift</td>
<td>Hemianopic Alexa</td>
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Functional Areas of the Brain

Frontal Lobe
- Thinking, planning, problem solving, emotions, behavioral control, decision-making

Parietal Lobe
- Perceptions, object identification, language, knowledge of numbers, visuospatial processing

Temporal Lobe
- Memory, understanding language, facial recognition, hearing, vision, speech, emotion

Occipital Lobe
- Vision, visual processing, colour identification

Cerebellum
- Gross and fine motor skills, hand-eye coordination, balance

Brain Stem
- Regulates body temperature, heart rate, respiration, breathing
Cognitive Rehabilitation
Functional Areas of the Brain

Ischemic Stroke
• Blood Clot or Other Blockage
• Can be “Focused” or “Global” (Depending on Location)
• ~ 88% of Strokes

Hemorrhagic Stroke
• Ruptured Artery
• Usually “Global”
• ~ 12% of Strokes

Stroke:
“The sudden damage or death of brain cells due to lack of oxygen, caused by blockage of blood flow or rupture of an artery to the brain”

Leading Cause of Disability in the US; Fourth-Leading Cause of Death
Cognitive Rehabilitation

Long-term Effect of Stroke - Follow-up after 90 Days

Duration Determines Severity
• > 2 min. => Cell Death (Irreversible)
• < 2 min. => Cell Damage (Reversible?)
Pressure on Neighboring Areas => Damage (Reversible?)

Damage to the Brain from:
• Bruising
• Hemorrhage
• Stretching
Usually “Global”
“Contre-Coup” Injury
Opposite the Area of Impact

Traumatic Brain Injury:
“The sudden damage or death of brain cells due to a violent blow or jolt to the head OR by an object penetrating the skull”

Leading Cause of Death in Adults < 45 yrs, and in Children 1 – 15 yrs
Cognitive Rehabilitation
Causes of Cognitive Deficits

TBI's Reported thru ER Visits

52,000 Deaths
275,000 Hospitalizations
1,365,000 Emergency Department Visits

Slow Decline in Cognitive Function
Multiple Sclerosis - ~400,000 Cases
Dementia - 5,000,000* Cases

Most Common Cause of Dementia = Alzheimer's

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Cognitive Rehabilitation
Restoring Cognitive Function

Neuroplasticity:
"Changes in Neural Pathways and Synapses due to changes in behavior, environment, thinking or emotions.

Cognitive Rehabilitation
Basics of Cognitive Rehabilitation

Cognitive Rehabilitation
“A therapy program to help cognitively impaired individuals restore normal functioning, OR to compensate for cognitive deficits”

Attention
Memory
Executive Function
VisuoSpatial Processing
Visual Field
Cognitive Rehabilitation
Restoring Cognitive Function

Restitution
Re-establishing / Strengthening Damaged Neural Pathways

Reorganization
Developing / Strengthening NEW Neural Pathways

Compensation
New Strategies / External Aids

Attention

Intensity
Providing attention

Selectivity
Filtering processes

- activation of attention (alertness)
- selective or focused attention
- sustained attention & vigilance
- visual or spatial attention, change of the attention focus
- divided attention
Attention

- Alertness
- Selective Attention
- 2D / 3D Spatial Processing
- Change of Focus
- Sustained Attention
- Working Memory
- Visual Scanning

Memory

- Necessary for Learning
- Necessary for **ALL** ADL’s
- Affects other cognitive functions
- Affects Cognitive Rehabilitation
- 3rd Most Common Deficit after a Stroke / TBI (~ 65% of Patients)

**Memory:**

“The ability to encode, store, retain and subsequently recall information and past experiences in the brain”
Memory

Problem Solving

Reasoning

Calculating

Verbal Comprehension

Executive Function:

- Necessary for “Purposeful” Behavior
- Necessary for ALL ADL’s
- Directs All other Cognitive Functions
- Affects Cognitive Rehabilitation
- 2nd Most Common Deficit after a Stroke / TBI (~ 75% of Patients)

Executive Function:
“The coordination of multiple cognitive functions to produce a coherent, goal-directed result”
Executive Function

Planning & Follow Thru

Cognitive Flexibility

Risky Behavior

Emotional Outbursts

Executive Function
VisuoSpatial Processing

- Predominant Method for Processing Information
- Subconsciously Driven (difficult to Explain, Teach or Initiate)
- Affects Cognitive Rehabilitation
- Affects ALL Areas of ADL's
- Common Deficit after Stroke or TBI:
  - after LH Trauma 30 - 50%
  - after RH Trauma 50 - 70%

VisuoSpatial Processing: "The analysis of complex visual stimuli which allow us to perceive "whole" objects and the spatial relationships among them."

VisuoSpatial Processing

- Identifying "Incomplete" Objects
- Mental Imagery
- Mental Maps
- Depth Perception, Vertical, Horizontal
- Mental Rotation
VisuoSpatial Processing

"Visuo-Constructive Skills"

VisuoSpatial Processing

Copying a Drawing

Assembling 2-Dimensional Objects

Assembling 3-Dimensional Objects

Visual Field

• Predominant Pathway for Receiving Information

• Common Deficit Immediately after Stroke (45% - 65% of Ischemic Patients)

• Less Common as Long-term Deficit after Stroke (8% - 25% of Ischemic Patients)

• Relatively Uncommon Deficit after TBI (5% - 10% of Patients)… however Vision Problems very Common after TBI

• Affects Cognitive Rehab, ALL Areas of ADL’s

Visual Field:

"The entire expanse of space visible at a given instant without moving the eyes"
Visual Field Deficits

Patients Often Unaware of Visual Field Deficits

Patient May Notice Consequences (e.g. Bumping into Things)

Often Blame Problems on Other Causes (e.g. Poor Lighting)

Recognizes Visual Field Loss, But Thinks it is a Vision Problem

HemiSpatial Neglect: “The inattention to, or lack of awareness of one side of space”

- Attention Deficit (NOT a Visual Field Deficit)
  - Common Immediately after Stroke
    - (43% of Patients w/ Right Brain Lesion)
    - (20% of Patients w/ Left Brain Lesion)
  - Less Common at 3 months
    - (17% after Right Brain Lesion)*
    - (5% after Left Brain Lesion)
  - Usually Contralateral to Brain Lesion
  - Often Affects Multiple Senses (Visual, Auditory, Tactile)
  - Often Confused with Hemianopia
  - Often Co-Occurs with Hemianopia
  - Often Misdiagnosed as Hemianopia
  - Impact on ADL’s Similar to Hemianopia

* Ringman et. al - Frequency, risk factors, anatomy, and course of unilateral neglect in an acute stroke cohort - J. Neurology, 2004
Who Gets Cognitive Rehabilitation?

Common Patient Symptoms

• Decrease in intellectual functioning
• Slowed processing speed
• Memory loss/Forgetfulness
• Difficulty with language (e.g., word retrieval, comprehension)
• Speech
• Emotional changes (e.g., frustration, depression, impulsivity)
• Changes in insight
• Attention and Concentration changes (e.g., Easily distracted)
• Difficulty with planning and/or multitasking
Characteristics of Brain Injury: Physical

- Paralysis (quadriplegia) or weakness (quadriparesis) in both the arms and legs
- Paralysis (hemiplegia) or weakness (hemiparesis) on one side of the body
- Impaired fine motor skills, sometimes with tremors
- Poor overall body coordination (ataxia)
- Double vision (diplopia)
- Visual field cuts
- Motor speech disorders like dysarthria and difficulties in oral speech planning (oral apraxia)
- Inability to carry out learned movements (apraxia)

Characteristics of Brain Injury: Cognitive

- Impaired attention and concentration
- Memory impairment for learning and recall of new information
- Impaired problem-solving and decision-making skills
- Slowed information processing speed
- Impulsive thinking without regard for consequences
- Poor organization, planning, and sequencing abilities
- Impaired concept formation and abstract thinking
- Inflexible thinking and mental rigidity
- Poor judgment, especially in social situations

(Neuroskills.com)
Characteristics of Brain Injury: Behavioral

- Inability to engage in purposeful activity
- Disinhibition
- Inability to respond appropriately to environmental cues
- Socially inappropriate behavior
- Social skills deficits
- Impulsivity
- Poor initiation and apathy
- Lack of insight into behavior and its consequences
- Inability to profit from experience
- Denial of deficits
- Poor self-esteem

(Neuroskills.com)
Where does Cognitive Rehabilitation Take Place?

Acute Care Hospital
Acute Inpatient Rehabilitation Hospitals
Skilled Nursing Facilities
Outpatient Rehabilitation Services
Home Health Services

Key Components of Cognitive Rehabilitation

• Part of a multi-disciplinary approach
• Standard battery of assessments
• Patient education about cognitive strengths and weaknesses
• Clear goal setting and treatment planning
• Intervention involving the practice of functional tasks, and the use of internal and external compensatory strategies
• Continued evaluation
Multidisciplinary, Collaborative Care

Collaboration between disciplines is essential, in order to:

• Meet the needs of a diverse population with individual needs
• Meet the complexity of any patient’s needs in a comprehensive way
• Promote continuity of care
• Match a diverse set of interventions to functional needs
• Communicate about goals and treatment planning
• Reduce costs
• Improve patient outcomes

Who are the Providers?

Occupational therapist
Physical therapist
Speech/language pathologist
Neuropsychologist, or other psychologist
Neuropsychiatrist, psychiatrist, other physician
Other allied health providers
### Occupational Therapist

- Helps patients regain functioning within home, work or school, or community settings
- Determines impact of impairments on everyday activities, incorporating knowledge of neurology and neuro-anatomy
- Measures functional loss and design an intervention plan, from acute care to community reintegration

### Physical Therapist

- Evaluate and diagnose movement dysfunction and use interventions to treat patient/clients
- May provide therapeutic exercise, functional training, manual therapy techniques, assistive and adaptive devices and equipment, and physical agents and electrotherapeutic modalities
- Often consults and practices with a variety of other professionals
Speech-Language Pathologist

- Assesses, diagnoses, and treats communication disorders associated with cognitive, language and speech impairments.

- Understands communication behavior and the underlying neurology, cognitive, sensory, and motor processes that are required to communicate.

- Addresses the impact of cognitive and communication disorders in activities and participation in society.

Neuropsychologist, or other psychologist

- Assesses, diagnoses, treats, and prevents mental disorders.

- Uses a variety of approaches.

- Designs and implements behavior modification programs.
MD, (including Neurologist and Physiatrist)

Neurologist
- Examines patients with neurologic disorders or impaired function of the brain, spinal cord, peripheral nerves, muscles, autonomic nervous system, and related blood vessels
- Generally sees patients referred by other physicians
- Investigates, diagnoses, and treats neurological disorders

Physiatrist
- Treats impairments and disabilities resulting from variety of conditions
- Designs and coordinates a treatment plan with goal of maximizing functional capacity and restoring quality of life as much as possible.

Other providers

Nurses
Social Workers
Recreational Therapists
Audiologists
Kinesiotherapist
Neuro-Ophthalmologist
Rehabilitation Counselor
The Role of Families

The family/support system of the patient plays an important role in intervention and should be actively involved throughout treatment.
Goals of Cognitive Rehabilitation

- Enhance capacity to process and interpret information
- Improve ability to function in all aspects of family and community life

Components of Cognitive Rehabilitation

- **Retraining** or **restoring** cognitive processes that have been impaired by injury/illness.
- Functional improvements are made over many months, or even years.
- AKA process training
- Development of new **compensatory** skills to enhance daily performance.
- Retained skills and functional reorganization are used to learn new strategies.
Cognitive Rehabilitation Therapy Strategies

Restitution
Re-establishing / Strengthening Damaged Neural Pathways

Compensation
Using New Strategies / External Aids

Reorganization
Developing / Strengthening New Neural Pathways

Cognitive Rehabilitation Intervention Characteristics

Structured
Systematic
Goal-Directed
Individualized
Involve learning, practice, social contact, and relevant context.

Repetitive
Figure 1. A provisional model of cognitive rehabilitation.
Cognitive Skill Areas

- Executive Functions
- Memory
- Information Processing
- Visual Processing
- Attention

Cognitive Rehab Strategies

- Process Training
- Strategy Training
- Functional Activities Training
- Computer-Assisted Strategies
- Compensatory Strategies
- Stimulation Therapy
- Attention-Concentration Training
- Domain-Specific Training
- Indirect Training
Computer-assisted Cognitive Rehabilitation

Computer Assisted Cognitive Rehab:
- Mild Deficits
- Moderate Deficits
- Severe Deficits

Memory Therapy

Memory Strategies
- Mnemonic Devices
- PQRST
- Vanishing Cues
- Errorless Learning
- Spaced Retrieval
Visual Field Therapy

Visual Restoration Training

Visual Field Therapy

Saccadic Eye Movement

Adaptor & Test Locations

Saccadic Training
Examples

Drill and Practice
Recall Strategies:
  - Mnemonics
  - Cueing
  - Chunking
  - Spaced Retrieval
  - Method of Loci

Specific Interventions:
  - Face-name Recall
  - Number Recall
  - Story Recall
  - List/Object Recall
  - Procedural Memory
  - Fluency Training
  - Semantic Impairments

Evidence for Cognitive Rehabilitation

**REVIEW ARTICLE (META-ANALYSIS)**

**Evidence-Based Cognitive Rehabilitation: Updated Review of the Literature From 2003 Through 2008**

Keith D. Cicero, PhD, Donnie M. Langehnahn, PhD, Cynthia Branden, MA, CCC-SLP, James F. Mace, PhD, Kathleen Kalmar, PhD, Michael Fraus, PhD, Thomas Felicetti, PhD, Linda Lautsch, PhD, J. Preston Harley, PhD, Thomas Bergquist, PhD, Joanne Azulay, PhD, Joshua Cantor, PhD, Terese Achman, PhD

**ABSTRACT**

**Objective:** To update our clinical recommendations for cognitive rehabilitation of people with traumatic brain injury (TBI) and stroke, based on a systematic review of the literature from 2003 through 2008.

**Data Sources:** PubMed and Lottative literature searches were conducted using the terms attention, awareness, cognitive, communication, executive, language, memory, perception, problem solving, and/or reasoning combined with each of the following terms: rehabilitation, remediation, and training for articles published between 2003 and 2008. The task force initially identified citations for 198 published articles.

**Study Selection:** One hundred forty-one articles were selected for inclusion after our initial screening. Twenty-nine studies were excluded after further detailed review. Included articles were selected based on the criteria that the intervention was a cognitive rehabilitation treatment, the outcome measure was a standardized test of cognitive function, and the study design was a randomized controlled trial (RCT), a prospective cohort study, or a cross-sectional study.

**Data Synthesis:** Of the 112 studies, 14 were rated as class I, 5 as class IIa, 11 as class IIa, and 82 as class III. Evidence within each area of intervention was synthesized and recommendations for Practice Standards, Practice Guidelines, and Practice Options were made.

**Conclusion:** There is substantial evidence to support interventional therapies for attention, memory, social communication skills, executive function, and for comprehensive-biologic neuropsychological rehabilitation after TBI. Evidence supports visuospatial rehabilitation after right hemisphere stroke, and interventions for aphasia and apraxia after left hemisphere stroke. Together with our prior reviews, we have evaluated a total of 970 interventions, including 65 class I or IIa studies. There is now sufficient information to support evidence-based protocols and implement empirically-supported treatments for cognitive disability after TBI and stroke.

**Key Words:** Brain injuries; Practice guidelines as topic; Rehabilitation; Stroke.

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Evidence-Based Recommendations for Cognitive Rehabilitation: Practice Guidelines

Table 2: Evidence-Based Recommendations for Cognitive Rehabilitation: Practice Guidelines

<table>
<thead>
<tr>
<th>Intervention</th>
<th>Recommendations</th>
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<tbody>
<tr>
<td>Scanning training</td>
<td>Recommended as an important, even critical, element for persons with severe visuospatial impairment that includes visual neglect after right hemisphere stroke</td>
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<tr>
<td>Cognitive interventions for specific language impairments such as reading comprehension and language formulation</td>
<td>Recommended after left hemisphere stroke or TBI</td>
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<tr>
<td>Treatment intensity</td>
<td>Should be considered as a key factor in the rehabilitation of language skills after left hemisphere stroke</td>
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<tr>
<td>Use of external compensations with direct application to functional activities</td>
<td>Recommended for persons with severe memory impairment after TBI or stroke</td>
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<tr>
<td>Training in formal problem-solving strategies and their application to everyday situations and functional activities</td>
<td>Recommended during postacute rehabilitation for persons with stroke or TBI</td>
</tr>
<tr>
<td>Comprehensive-holistic neuropsychologic rehabilitation</td>
<td>Recommended during postacute rehabilitation to reduce cognitive and functional disability for persons with moderate to severe TBI or stroke</td>
</tr>
<tr>
<td>Isolated microcomputer exercises to treat unilateral left neglect</td>
<td>Not recommended; does not appear effective</td>
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</table>
Cognitive Rehab Should Be…

Context specific – intervention and supports within the routines of the person's everyday life.
Collaborative – between providers and patient's natural supports in everyday life
Collaborative – with patient who has the injury, offering choices and decision-making opportunities
Emphasize strategy training to compensate for residual deficits
Reduce disability and restore social role functioning
Establish relevant, functional outcomes
Should not focus on eliminating the underlying cognitive impairment

Directed toward improving everyday functioning
Include attempts to promote generalization or directly apply compensatory strategies in functional contexts.
Concentrate on long-term maintenance of improved functional outcomes
Include continued support and intervention for patient and family