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THE OHIO STATE UNIVERSITY
WEXNER MEDICAL CENTER

# "Arming" You with Therapies: Evidence Based Techniques for Upper Extremity Motor NeuroRehabilitation

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## Outline

- Describe neuroplasticity and its relevance to upper extremity rehabilitation.
- Identify and briefly describe 2 tools for finding evidence for upper extremity rehabilitative therapies.
- Identify and describe two assessment strategies for measuring upper extremity status.
- Briefly describe the Brunnstrom stages.
- Recognize the Brunnstrom stages with choices for upper extremity treatment strategies.
- Identify four strategies for increasing affected arm use and function.


## What is Evidence-based practice?

Evidence-based practice (EBP) stresses "the conscientious, explicit, and judicious use of *current best evidence* in making decisions about the care of individual patients. The practice of evidence-based medicine… means integrating individual clinical expertise with the *best available* external clinical evidence from systematic research“

(Sackett, Rosenberg, Gray, Haynes, & Richardson, 1996, p. 71).

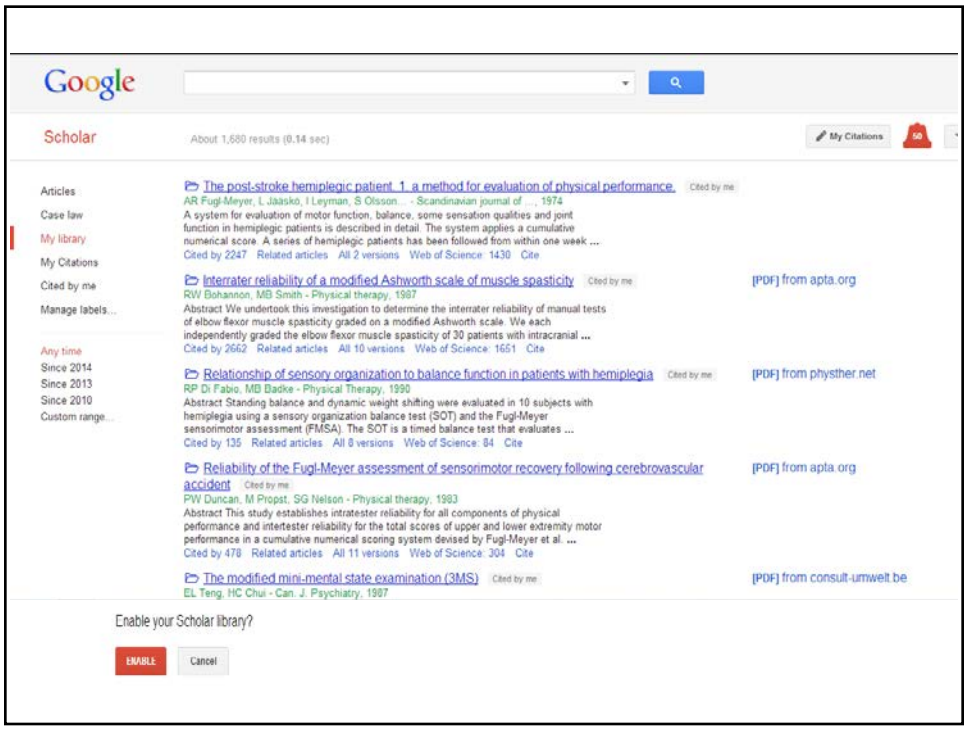
## Where can I find evidence *fast??*

| What you are looking for | Where to find it |
|---|---|
| Generalized search for Peer-reviewed articles, books, abstracts and articles. | scholar.google.com |
| Stroke rehabilitation meta-analysis | ebrsr.com |
| All peer reviewed studies | pubmed.com |
| A breakdown of all peer reviewed literature into subcategories including “Therapy” | www.tripdatabase.com |
| Rehabilitation research | naric.com/research |

# Managing Evidence:
## *"Push" and "Pull" methods*

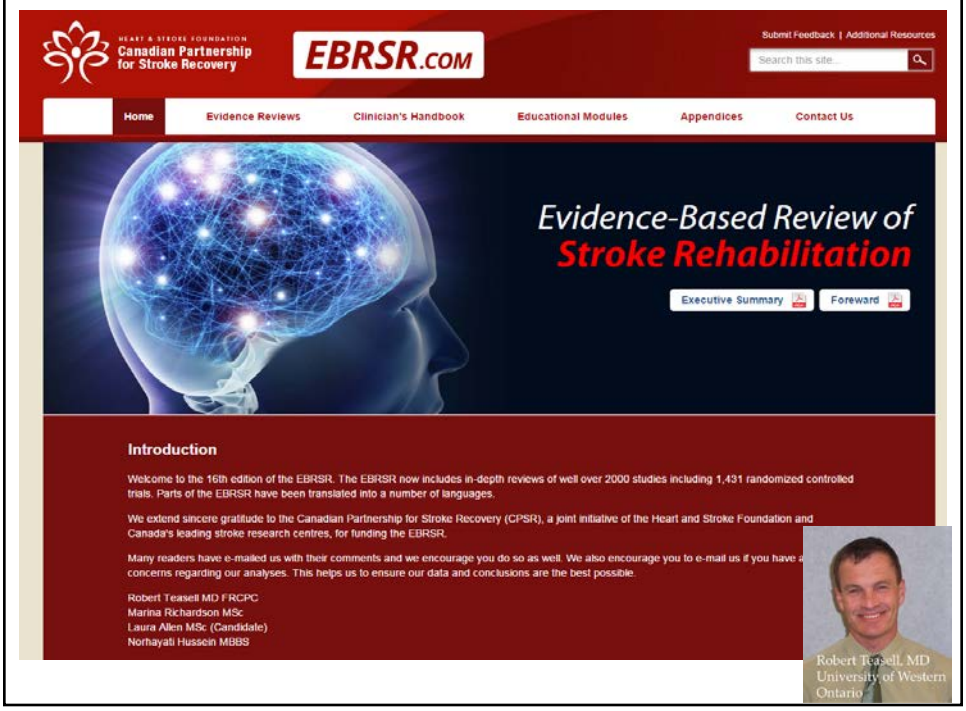
- "Pull" – access information when needed
  - Traditional Method - "Just in Time" learning
- "Push" - alerts us to new information
  - "Just in Case" learning

# scholar.google.com

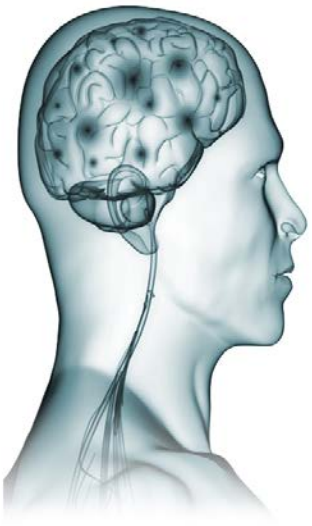
# Use open access resources

- Directory of Open Access Journals
  - www.doaj.org
- BiomedCentral
  - www.biomedicentral.com
- Google
  - Google Scholar
- PubMed
  - The NIH Mandate (see next slides on PubMed)
- Examples:
  - Physical Therapy Journal
  - Journal of Rehabilitation Research & Development
    - www.research.va.gov/programs/rrd.cfm
  - Stroke. (**Free one year after publication** )
    - http://stroke.ahajournals.org



Evidence-Based Review of
Moderate to Severe Acquired Brain Injury

HOME MODULES CASE STUDIES EDUCATIONAL MODULES GUIDELINES HANDBOOK



## WELCOME & INTRODUCTION

The Evidence-Based Review of Moderate To Severe Acquired Brain Injury (ERABI) is a joint project to develop an evidence-based review of the literature for rehabilitation or rehabilitation-related interventions for acquired brain injury (ABI). The principle of the ERABI is to improve the quality of ABI rehabilitation by synthesizing the current literature into a utilizable format and laying the foundation for effective knowledge transfer to improve programs and services.

The **ERABI** was designed to identify two areas:

1. Areas in rehabilitation for which strong evidence for effectiveness is lacking and therefore require further research;
2. Areas where the research evidence is strong and should be transferred effectively to improve programs and services.

The ERABI team would like to thank the Ontario Neurotrauma Foundation (ONF) for their ongoing support.

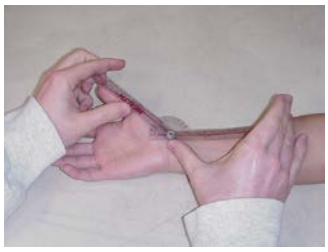
Please take a moment to complete this quick survey about ERABI online!

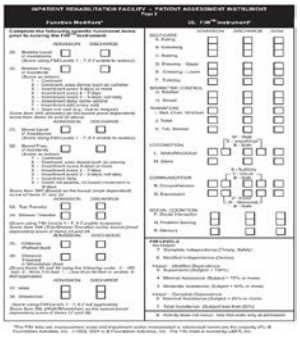
# Stroke Edge: Recommendations for outcome measures in different environments

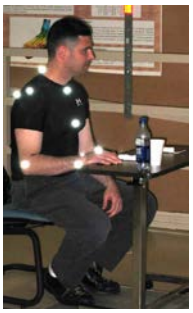
| | Practice Setting | | | | |
|---|---|---|---|---|---|
| MEASURES | Acute | IP Rehab | Home | SNF | OP |
| Brunnel Balance Test | 2 | 2 | 2 | 2 | 2 |
| Chedoke Arm Hand Inventory | 1 | 1 | 1 | 1 | 1 |
| Functional Ambulation Categories | 2 | 3 | 2 | 2 | 2 |
| Fugi-Meyer Sensory Exam | 1 | 1 | 1 | 1 | 1 |
| Modified Rankin Scale | 3 | 3 | 3 | 3 | 3 |
| Rate of Percieved Exertion | 1 | 1 | 1 | 1 | 1 |
| Reintegration to Normal Living | 1 | 1 | 2 | 1 | 2 |
| Satisfaction with Life Scale | 2 | 2 | 2 | 2 | 2 |
| Trunk Control Test | 1 | 1 | 1 | 1 | 1 |
| 5 Time Sit to Stand | 3 | 3 | 3 | 3 | 3 |
| 6 Minute Walk | 4 | 4 | 4 | 4 | 4 |
| 9 hole peg test | 1 | 3 | 3 | 3 | 3 |
| Action Research Arm Test | 3 | 3 | 3 | 3 | 3 |
| Activities-Specific Balance Confidence Test | 1 | 3 | 3 | 3 | 3 |
| Arm Motor Ability Test | 1 | 3 | 3 | 3 | 3 |
| Ashworth | 3 | 3 | 3 | 3 | 3 |
| Assessment of Life Habits | 1 | 3 | 3 | 3 | 3 |
| Balance Evaluation Systems Test | 2 | 2 | 2 | 2 | 2 |
| Berg Balance Test | 3 | 4 | 4 | 4 | 4 |
| Box & Blocks Test | 3 | 3 | 3 | 3 | 3 |
| Canadian Occupational Performance Measure | 1 | 2 | 2 | 2 | 2 |
| Chedoke-McMaster Stroke Assessment | 3 | 3 | 3 | 2 | 3 |
| Dynamic Gait Index | 4 | 4 | 4 | 4 | 4 |
| Dynamometry | 1 | 3 | 1 | 1 | 3 |
| EuroQOL | 1 | 3 | 3 | 3 | 3 |
| Falls Efficacy Scale | 2 | 3 | 2 | 2 | 2 |
| Functional Independence Measure | 2 | 4 | 2 | 2 | 2 |
| Fugi-Meyer Assessment of Motor Performance* | 4 | 4 | 4 | 4 | 4 |
| Functional Reach | 4 | 4 | 4 | 4 | 4 |
| Goal Attainment Scale | 2 | 4 | 2 | 2 | 2 |
| Hi Mat | 2 | 2 | 2 | 2 | 2 |
| Jebsen Taylor Arm Function Test | 1 | 2 | 2 | 2 | 2 |
| Modified Fatigue Impact Scale | 1 | 1 | 2 | 2 | 2 |
| Motor Activity Log | 1 | 4 | 4 | 4 | 4 |
| NIH Stroke Scale | 3 | 3 | 3 | 3 | 3 |
| Nottingham Assessment of Somatosensation | 1 | 2 | 2 | 2 | 2 |
| Orpington Prognostic Scale | 4 | 4** | 1 | 1 | 1 |
| Postural Assessment Scale for Stroke Patients | 4 | 4 | 4 | 4 | 4 |
| Rivermead Assessment of Somatosensory Performance | 1 | 1 | 1 | 1 | 1 |

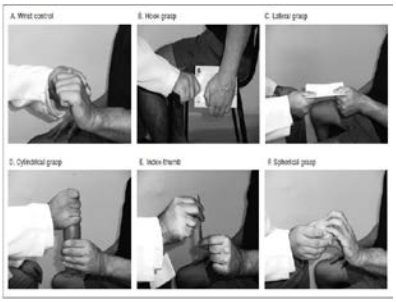
http://www.neuropt.org/professional-resources/neurology-section-outcome-measures-recommendations/stroke

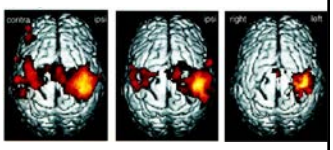
# Upper Extremity Neurological Assessment











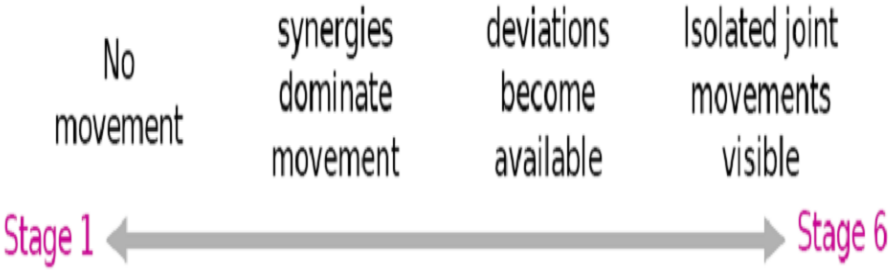
## Signe *Brunnstrom*

- Swedish Fulbright Scholar
- William Fulbright - Former U.S. Senator and SS.
- Brunnstrom authored several books and dozens of journal articles about human movement and the treatment of patients with hemiplegia.

## The Brunnström stages simplified


for assessment

## What do the Brunnstrum stages and "recovery" represent neurophysiologically??

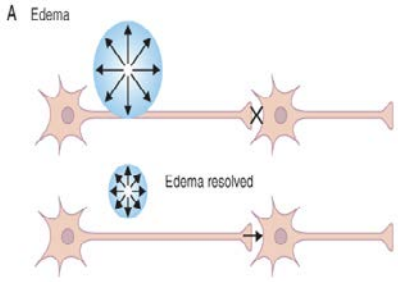



What are we saying when someone is "recovering?"

# *Some* of the processes include:

Reduction of swelling

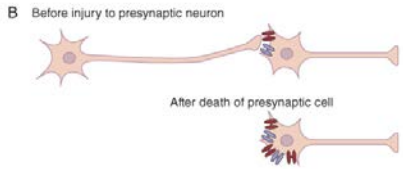
- restore blood flow to intact synapses
- reduces physical pressure
- action potentials resume



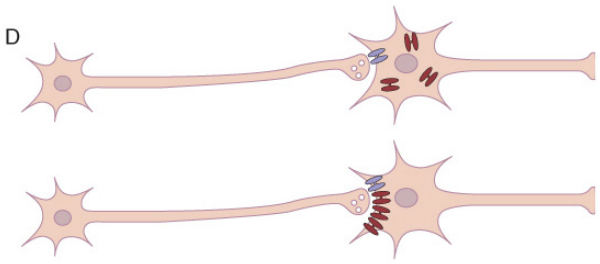

"The prenumbra" – some believe that's all there is!!!

Denervation hypersensitivity

- new receptor sites develop on postsynaptic membrane.
- WHY? Less neurotransmitter → development of additional receptor sites
- Receipt of neurotransmitters from adjacent sites



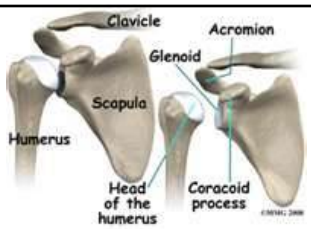
Unmasking of silent synapses




Synapses are unused until injury occurs; Injuries to other pathways causes their activation.

**HOW DO WE ASSESS THESE BRAIN PROCESSES (OR LACK THEREOF)?**

SPASTICITY




SUBLUXATION

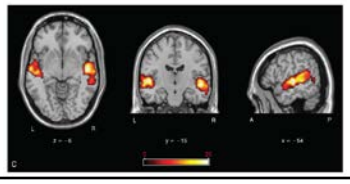
ARTHRITIS

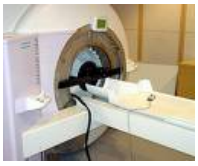
Neuroimaging let's us see change that we may not see if the patient has the above and we use the below.

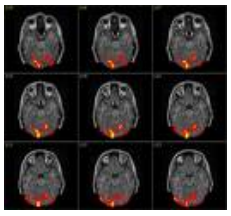
## How is current status and response to therapy measured?

- Most common methods:
  - Transcranial Magnetic Stimulation (TMS)

  - **Functional** Magnetic Reasonance Imaging (fMRI)
    - Functional areas *should* light up according to use
    - DTI can be added







# Reflex Testing


REFLEX SCALE

0 : Absent - No visible or palpable muscle contraction even with reinforcement

1+ : Hyporeflexia - Slight or sluggish muscle contraction with little or no joint movement. Reinforcement may be required to elicit a reflex response.

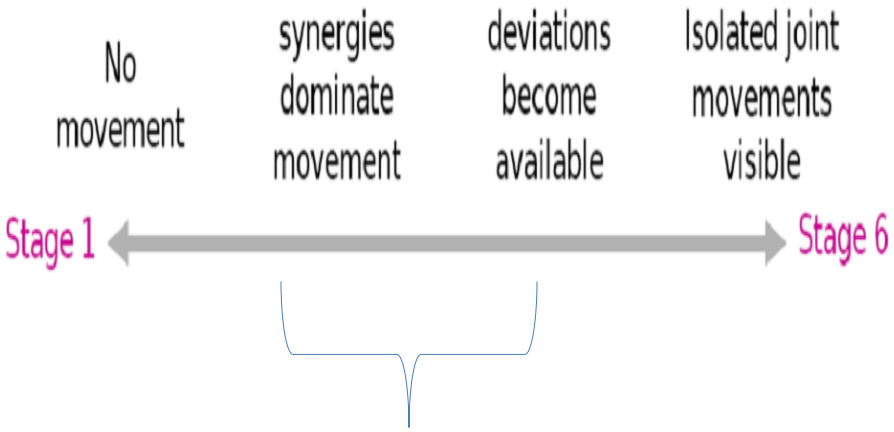
2+ : Normal - Slight muscle contraction with slight joint movement

3+ : Hyperreflexia - Clearly visible, brisk muscle contraction with moderate joint movement.

4+ : Abnormal - Strong muscle contraction with one to three beats of clonus. Reflex spread to contralateral side may be noted.

5+ : Abnormal - Strong muscle contraction with sustained clonus. Reflex spread to contralateral side may be noted.

# UE Spasticity Testing




| | |
|---|---|
| 0 | No increase in muscle tone |
| 1 | Slight increase in muscle tone, manifested by a catch and release or by minimal resistance at the end of range of motion |
| 1+ | Slight increase in muscle tone, manifested by a catch, followed by minimal resistance throughout the remainder (less than half) of the range of motion |
| 2 | More marked increase in muscle tone through most of the range of motion, but the affected part is easily moved |
| 3 | Considerable increase in muscle tone, passive movement is difficult |
| 4 | Affected part is rigid in flexion or extension (abduction or adduction, etc.) |

## Ashworth: General considerations

- Should be done in supine.
- Passively move the joint rapidly and repeatedly through the available PROM and grade the resistance using the definitions.
- Ask the patient if there is any pain in the arc
- Ashworth prior to goniometric measurements

What mm causes the most tone → elbow flx?

Elbow (**1st = Most spasticity brachioradials, 2nd = biceps, 3rd = brachialis)**

- With the patients elbow fully flexed.
- Palm of the hand facing inward (neutral sup/pro)
- Extend the patients forearm from maximum possible flexion to maximum possible extension

not more than three consecutive times and rate the muscle tone.

## Wrist (wrist flexors)

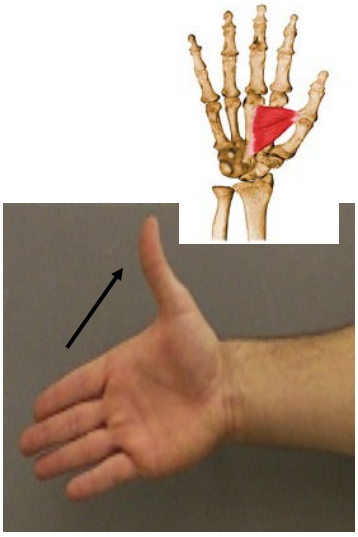
- Elbow as straight as possible and the forearm pronated so that so that the palm of the hand is facing downward
- Move the wrist from max possible flexion to max possible extension

not more than three consecutive times and rate the muscle tone.

## Finger Flexors:

- **elbow as straight as possible**
- **palm of the hand facing inward (neutral supination)**
- **wrist in neutral**
- **open and close the fingers**
- **not more than three consecutive times and rate the muscle tone.**

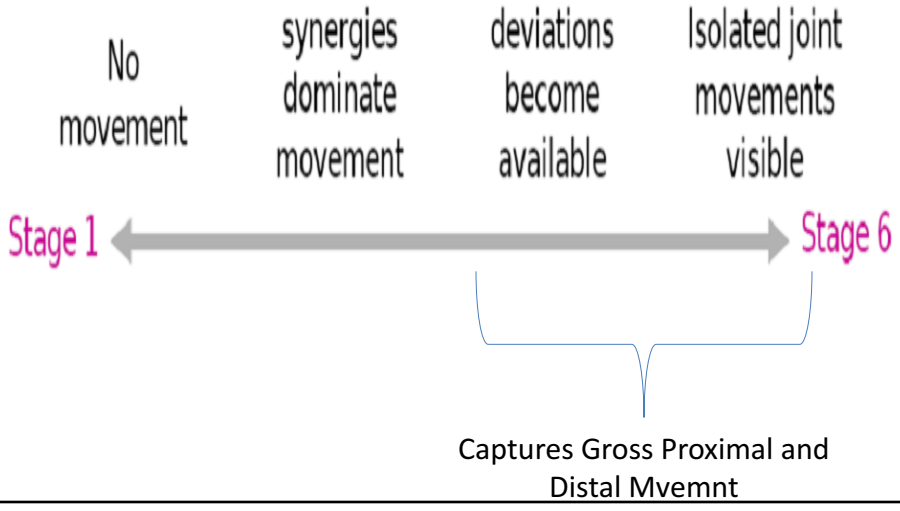
## Thumb: Adductor Pollicis



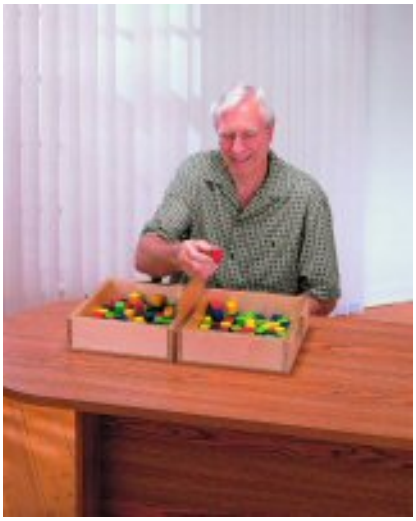
- Elbow as straight as possible
- Palm of the hand facing inward (neutral supination)
- Raise and lower the thumb form max possible flexion to max possible extension not

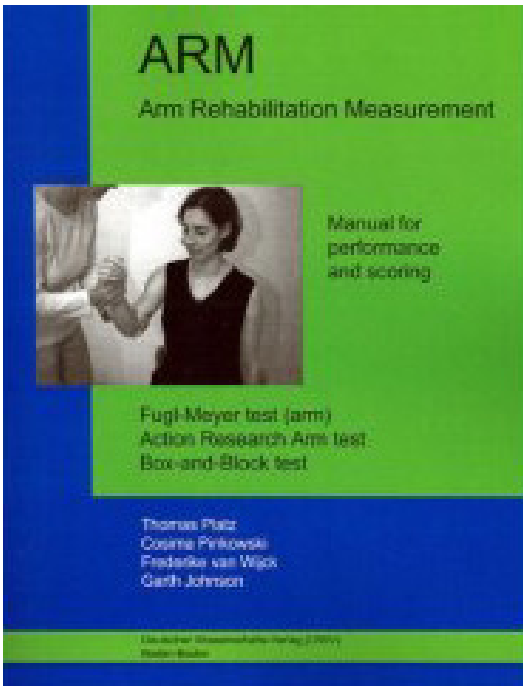
Not more than three consecutive times and rate the muscle tone

## The Box & Block



## Box and Block






## The ARAT

| No movement | synergies dominate movement | deviations become available | Isolated joint movements visible |
|---|---|---|---|

Stage 1 ⟷ Stage 6

Captures Distal Mvemnt

# The Action Research ArmTest

- Nuray Yozbatiran, Lucy Der-Yeghiaian and Steven C. Cramer
- **A Standardized Approach to Performing the Action Research Arm Test**
- *Neurorehabil Neural Repair* 2008; 22; 78

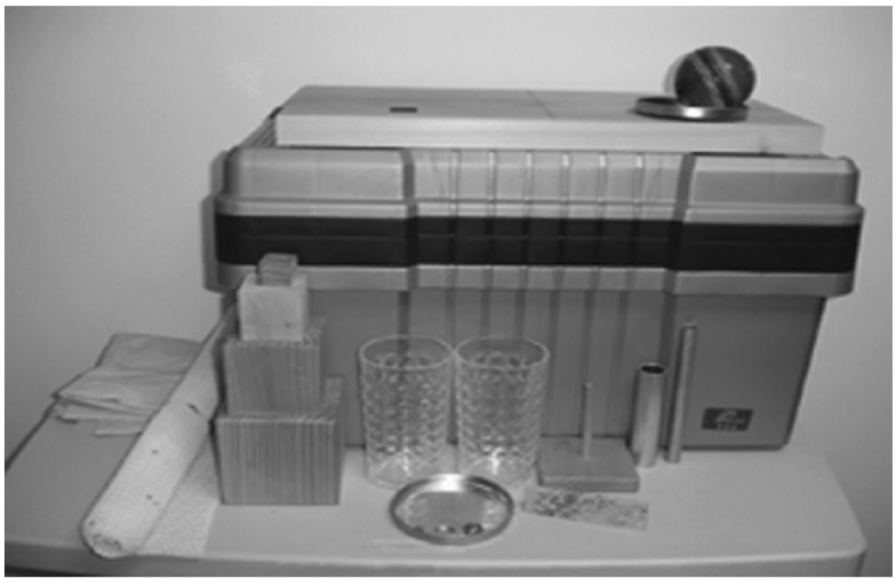
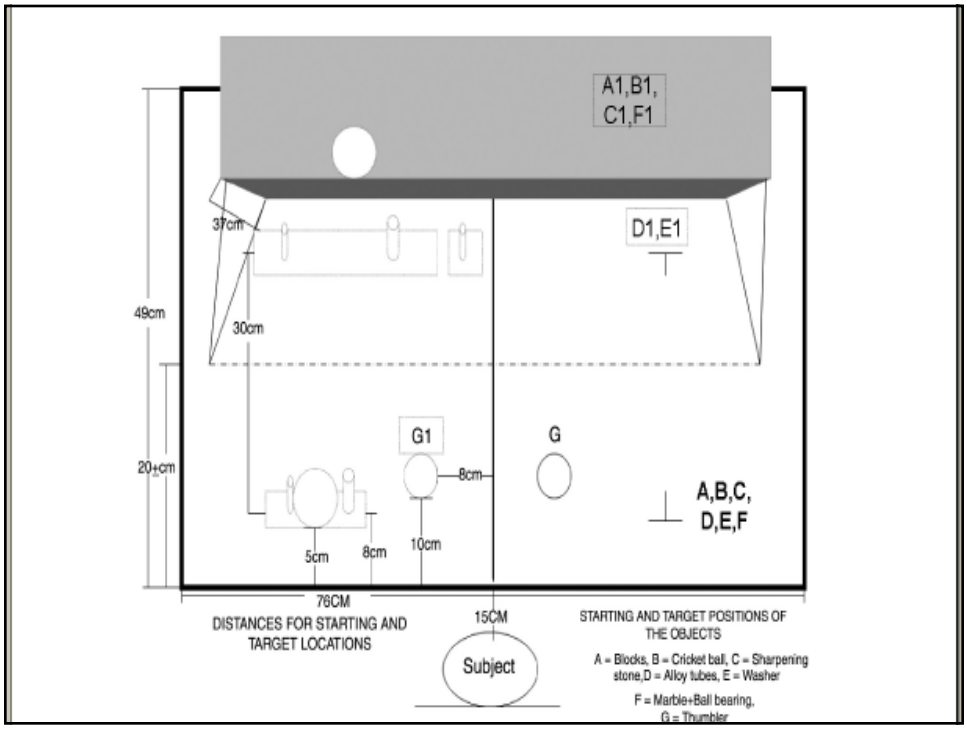
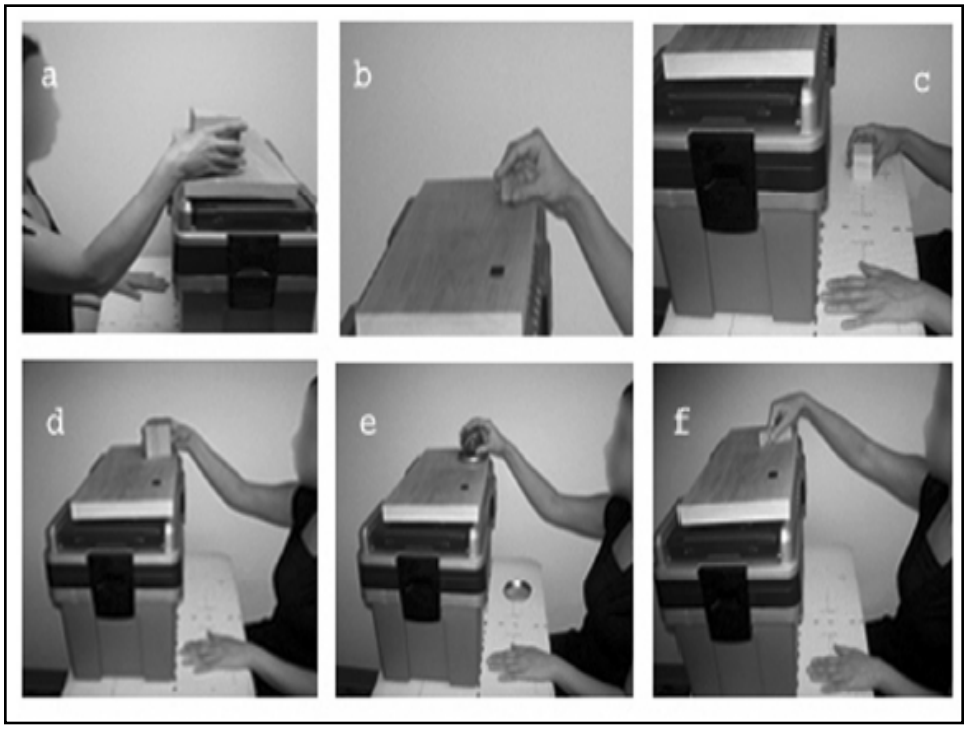


Figure 1. The complete ARAT kit is displayed.

| Task Material | Dimensions |
|---|---|
| Table | Height, 75 cm; width, 76 cm; depth, 49 cm |
| Chair | Height of seat 46 cm from floor; no arm rests |
| Shelf (or box on the table) | 37 cm above level of table |
| Four wooden blocks | 10.0, 7.5, 5, and 2.5 $cm^3$, respectively |
| Large alloy tube | Diameter, 2.5 cm; length, 11.5 cm |
| Small alloy tube | Diameter, 1 cm; length, 16 cm |
| Cricket ball | Diameter, 7.1 cm |
| Marble | Diameter, 1.6 cm |
| Sharpening stone | 10.0 × 2.5 × 1 cm |
| Ball bearing | 6-mm diameter |
| Two plastic tumblers | Upper diameter, 7 to 8 cm; lower diameter, 6 to 7 cm; height, 12 to 15 cm |

| Task Material | Dimensions |
|---|---|
| Washer | Outer diameter, 3.5 cm; inner diameter, 1.5 cm |
| Plank for the tubes | |
| Starting point | 1.5 × 8.5 × 8.5 cm |
| Target point | 3.5 × 8.5 × 34 cm |
| Bolt for the large alloy tube | |
| Starting position | Round wooden peg; diameter, 2.0 cm; height, 13.5 cm |
| Target position | Round wooden peg; diameter, 2.0 cm; height, 8.0 cm |
| Bolt for the small alloy tube | |
| Starting position | Round wooden peg; diameter, 0.8 cm; height, 6.0 cm |
| Target position | Round wooden peg; diameter, 0.8 cm; height, 6.0 cm |
| Plank for the washer | 1.5 × 8.5 × 8.5 cm |
| Bolt for the washer | Round wooden peg; diameter, 0.8 cm; height, 8.5 cm |
| Tin lid | Diameter, 9 cm; rim height, 1 cm |


A1,B1,
C1,F1
D1,E1
37cm
49cm
30cm
20±cm
G1
G
8cm
A,B,C,
D,E,F
5cm
8cm
10cm
76CM
15CM
Subject
DISTANCES FOR STARTING AND TARGET LOCATIONS
STARTING AND TARGET POSITIONS OF THE OBJECTS
A = Blocks, B = Cricket ball, C = Sharpening stone,D = Alloy tubes, E = Washer
F = Marble+Ball bearing,
G = Thumbler


a
b
c
d
e
f

## Treatments

## Treatments ideally occur with K.I.S.S.

# The P.R.A.C.T.I.C.E. Principles: Common Ingredients for Efficacious Neurorehabilitation

- Part whole practice
- Repetitive, task specific, and goal focused
- Activities should be meaningful to client
- Client driven – goals and content of practice
- Train in a practical way
- Emphasize accomplishments and awareness – copious, diverse feedback, self efficacy, home programs

Page & Peters, *Stroke,* 2014

43

| Part-whole practice | Break the desired task down into its smallest components, and practice those that are deficient. Do not break down tasks that are discrete or not normally performed segmentally. |
|---|---|
| Repetitive and goal focused | Focused on a particular task or task component and should allow opportunities for repetition |
| Activities should be salient | Meaningful to pt. |
| Client driven | Pt attempts as much as possible, pt designs regimen |
| Train practically | Easy to access, normal schedule & gear |
| Impairments addressed | Impairments addressed |
| Challenge regularly | Grade and re-grade regularly |
| Emphasize accomplishments | Multi-modal feedback that instills carryover, insight<br>Copious amounts feedback |

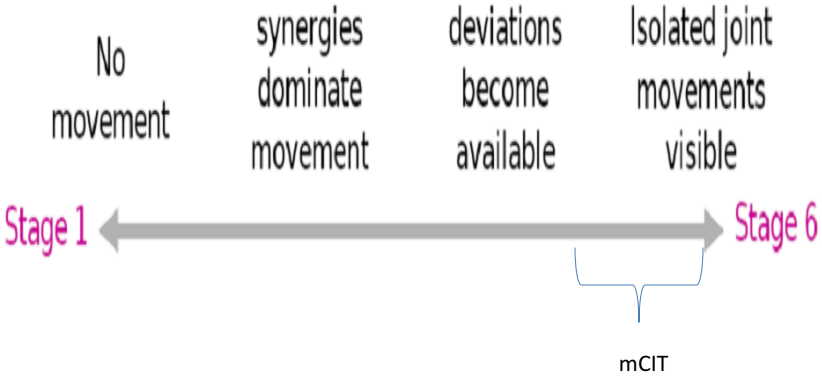
# A review of *some* approaches


A way to think about measurement

A way to think about therapies that are layered at different stages (instead of "one size fits all")

This is a clinical talk with research stuff; not a research talk with clinical stuff

# A review of *some* approaches



## If you are a stroke patient…

- And I asked you to reach for something, with which hand would you be more likely to perform the task; the affected or unaffected hand?
- Unaffected
- Why?
  - Learned Nonuse – a *behavioral* suppression of movement (not biologically based)
  - Operant conditioning
    - Success/punishment-operant conditioning
    - -therapy/compensation

## Constraint-induced movement therapy (CIT)

- Components <u>to induce repeated practice</u> with the affected UE include:
  - 6 hour training sessions on 10 consecutive weekdays
  - Mitt 90% of all waking hours during same 2 weeks
  - Behavioral strategies (log; shaping; behavioral contract)
- Increases more affected UE use & function in subacute & chronic CVA pts.

## Time for a little restraint?

- Could
- Can't
- Page
  - >
  - >
  - Lo
  - >
- Confi ives from
- Other
  - Re
  - C
  - C ed co
  - Ta ness, ar
  - Pl ve pa

ealth & Fitness

TUESDAY, JUNE 13, 2000

VITAL SIGNS
JOHN O'NEIL

The New York Times

Stroke Survivors Celebrate Success of Restraint Therapy

By EMILY YELLIN

BIRMINGHAM, Ala., June 6 — For Jesse Reed, 67, washing the dishes is a thrill.

For Janis Keeney, 43, switching a light on or off is so satisfying.

And James Faust, 65, is grateful every time he mows his lawn.

All three are stroke survivors who have gone through a promising therapy here at the University of Alabama-Birmingham's Spain Rehabilitation Clinic that has helped them regain use of their disabled arms to varying degrees.

"I had completely written my arm off," said Mr. Faust, who had a stroke in 1993 that disabled the right side of his body. "I just quit using it because it wouldn't do what I wanted it to do. I had deep thoughts about having it amputated to get it out of my way."

But then his wife read an ad about experimental rehabilitation called constraint-induced movement therapy for stroke survivors. So in 1998 Mr. Faust became a research subject.

Mr. Reed, who had a stroke that disabled his left side in 1994, also joined the study in 1999. Mr. Reed said that before the therapy, his left arm "was just a limb that was

James Faust, who suffered a stroke in 1993, says therapy has helped him regain 95 percent of the use of his arm.

use the limb and that only through intense use will the the brain be sufficiently rewired.

During two weeks of work with a physical therapist six hours a day, five days a week at the clinic, Mr. Faust said, his able left arm was immobilized in a sling, and his left hand was in a large mitten, forcing him to perform simple tasks with his disabled right arm. He began by turning over index cards and moving checkers onto squares.

"I didn't tell any difference until about the third day," Mr. Faust said. "And then there was a sensation in my arm that I hadn't had. I felt a little tingling. It was like my nerves were waking up."

Then he graduated to threading a shoelace through holes and moving washers up and down on screws.

Working at the clinic and on his own at home on weekends, he began to regain use of the arm and to do things he thought he might never do again, like eating dinner holding the fork with his right hand, just as he had done before the stroke.

Dr. Edward Taub leads the constraint-induced therapy research in the clinical psychology department at the University of Alabama and was also one of the authors of the recent study in Germany.

His research assistant in Alabama, Gitendra Uswatte, said the

he considered it part of his therapy.

Janis Keeney was in the third quarter of stroke survivors in the studies. Starting out with very limited ability, she said the therapy had brought "not great improvement" but enough to change her life.

Ms. Keeney's stroke occurred in 1997, when she was 40 and the mother of an 8-month-old girl and a 2-year-old boy. "Before the therapy," she said, "it was hard to hold them in my lap because I needed both hands. But now I can hold my children."

A former engineer, Ms. Keeney has come to appreciate her ability to do even the simplest tasks, like switching on a light or opening a dresser drawer.

Although more research needs to be done before this therapy will be widely accepted, a new private clinic is scheduled to open in Birmingham this fall to provide constraint-induced therapy to stroke survivors. Other researchers also say that more studies need to be done because the number of people in this study was so small and participants were not compared with a control group.

Some trials of the therapy are being started by the National Institutes of Health. For information, call (205) 975-9786.

The University of Alabama is also studying the use of constraint therapy on legs. And there are also trials being conducted here on the effectiveness of this type of therapy for those who have lost the use of a limb after traumatic brain injury, spinal cord injury and hip fractures.

"It's certainly not just for folks who have had strokes," said Jean E. Crago, a physical therapist at the university who has worked

## *Modified constraint-induced therapy: Translating "preclinical research" to care*

- Therapy 3 times/week for ½ an hour
- Practice with the more affected arm for 5 hours/day 5 days/week
- Behavioral techniques (log, shaping)
- ✓ Reimbursement (acute and OP)
- ✓ Enough time (acute – 4 units of OT; OP – 2-3 units)
- ✓ Conditioning/no overtraining
- ✓ Compliance
- ✓ More UE reps → more opportunity for operant conditioning
- ✓ Distributed practice schedule

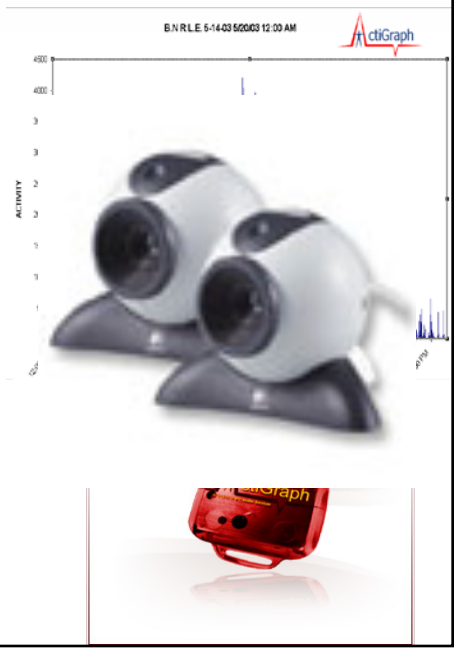
There are many different (and delicious) CIT/mCIT "flavors"
(and I don't care which one you use)

- 6 hours/day (Taub, Wolf, others)
- 3 hours/day (Sterr et al
- 1.5 hours/day (Taub's clinic)
- Ours (1/2 hour/day)
- Bottom line (again): dosing work needed, but it may just be that more than one version works

***There is strong (Level 1a) evidence of benefit of CIMT and mCIMT in comparison to traditional therapies in the chronic stage of stroke. Benefits***


## mCIT: Before The First Day of Treatment

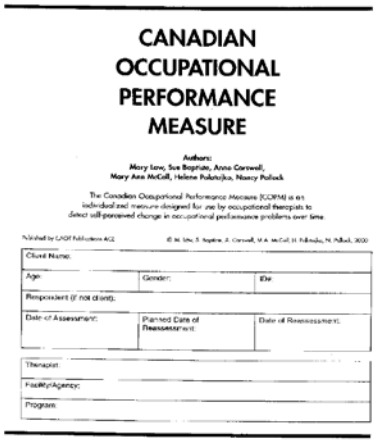
- Time before and after
- Video before and after
- Activity monitors
  - Objectively, quantitatively determine amount of use.
  - Patient takes home and wears for one week.
  - Easy to use – put into tray and tables come out (right).
  - Can be used as an outcome measure for therapy
  - **www.theactigraph.com/**



# Picking the Tasks…

*Tasks should be one or more of the following:*

- Important to the patient (motivating)
- Challenging Fun, interesting, engaging
- Necessary (feeding)
- We use the COPM & MAL
- Pt is regularly assessed; progressed in task difficulty when he/she can perform deficient component 70-80% of time



CANADIAN OCCUPATIONAL PERFORMANCE MEASURE

Authors:
Mary Law, Sue Baptiste, Anna Carswell,
Mary Ann McColl, Helene Polatajko, Nancy Pollock

The Canadian Occupational Performance Measure (COPM) is an individualized measure designed for use by occupational therapists to detect self-perceived change in occupational performance problems over time.

Published by CAOT Publications ACE © M. Law, S. Baptiste, A. Carswell, M.A. McColl, H. Polatajko, N. Pollock, 2000

Client Name:

Age: | Gender: | ID#:

Respondent (if not client):

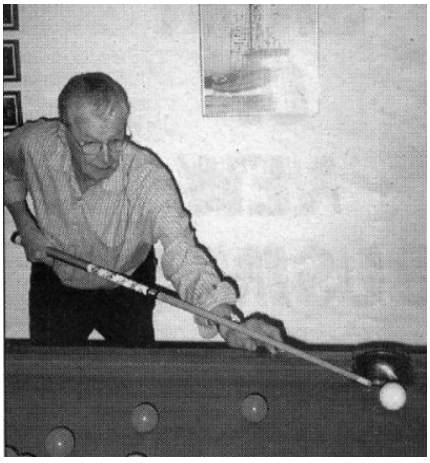
Date of Assessment: | Planned Date of Reassessment: | Date of Reassessment:

Therapist:

Facility/Agency:

Program:

# Scenario: R Hemi
1. Shooting Pool
2. Writing



## Shooting pool and Writing

| Component Movement *Italics=redundant* | M | W | F | M | W | F | M | W | F | Totals |
|---|---|---|---|---|---|---|---|---|---|---|
| *Shoulder flexion* | 10 | | | 5 | 5 | | | 5 | Total Movement Practice | 25 |
| Shoulder ABD. | | 10 | 5 | | | | 5 | 5 | | 25 |
| *Elbow extension* | 10 | 10 | 10 | 10 | 10 | 10 | 10 | 5 | | 75 |
| Ulnar dev. | 5 | 5 | 5 | 5 | 5 | 10 | 5 | 10 | | 50 |
| Wrist Flexion | | | | 10 | 5 | 5 | | 5 | | 25 |
| *Wrist ext* | | 5 | 5 | 5 | | 5 | | 5 | | 25 |
| *Finger extension* | 5 | | 5 | | 5 | 5 | 5 | | | 25 |
| *Finger flexion* | 5 | 5 | | 5 | 5 | | 10 TM * | 5 | | 25 |
| Letter Practice | 10 | 10 | 15 | 5 | 10 | 10 | 10 | 5 | | 75 |
| Total min./day | 45 | 45 | 45 | 45 | 45 | 45 | 45 | 45 | 45 | ⇩ 350 |

# Task Oriented Approach

- Based on systems model of motor control and theories of motor learning
- Therapist is a teacher of motor skills
  - Select contextually appropriate functional tasks
  - Vary tasks to increase transfer of learning
  - Structure the environment the conditions of the task are present
  - Provide feedback

  (Carr and Shepherd, 2003, and Gentile, 2000)

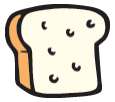
# Things you can grade

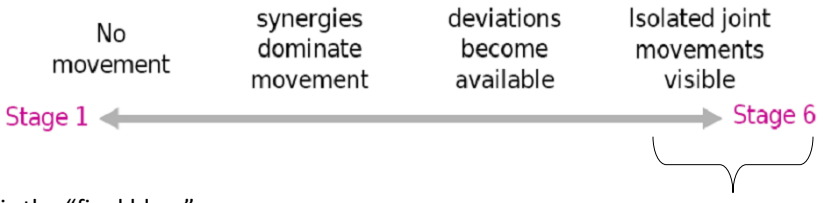
- Distance to reach or step
- Timed/ untimed
- Speed
- Duration
- Qualities of object
- Environment
- Contextual interference
- Several tasks learned and practiced together
- Demands (standing/ sitting)
- Number of repetitions
- Object placement
- Complexity: amount of steps
- Amount of cues or assistance given
- Number and kinds of distractions during tasks
- Gravity factor
  - With gravity → gravity eliminated → gravity

# Case Study

Video from personal collection of Christine Griffin. Used with permission.

## mCIT/CIT is *not* sliced bread



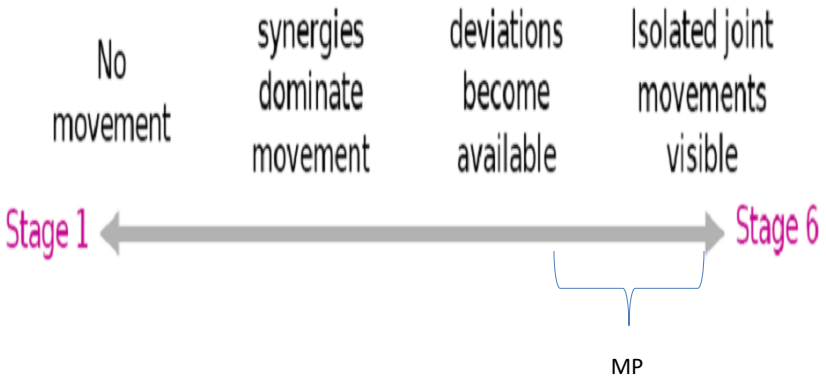



- It is the "final blow";
- Thus, as a team, you need to:
  - Have tools in your box that address the myriad of impairments that will *precede* mCIT (figure)
  - Look & see if you even have patients who fall in that 20% (mCIT prgm might be a waste of time)
  - Implement regular measurement techniques to gauge progress & mCIT readiness (other than the FIM) (NFL combine approach - FM, MAS, ARAT, video, timing)

So what do we do with the other 80%

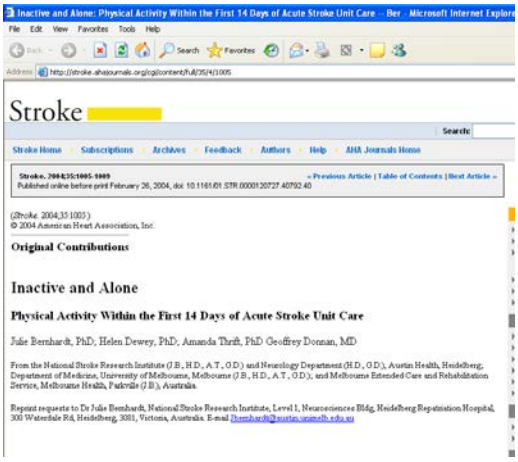
How do we "PRACTICE" with them?

# A review of *some* approaches




## Inactive and alone: Physical Activity Within the First 14 Days of Acute Stroke Unit Care

- 58 patients < 14 days after stroke from 5 metropolitan stroke units
- Observed them for 2 consecutive days at 10-minute intervals between 8 AM and 5 PM
- At each observation, they ascertained physical activity, location, and other person(s) present.

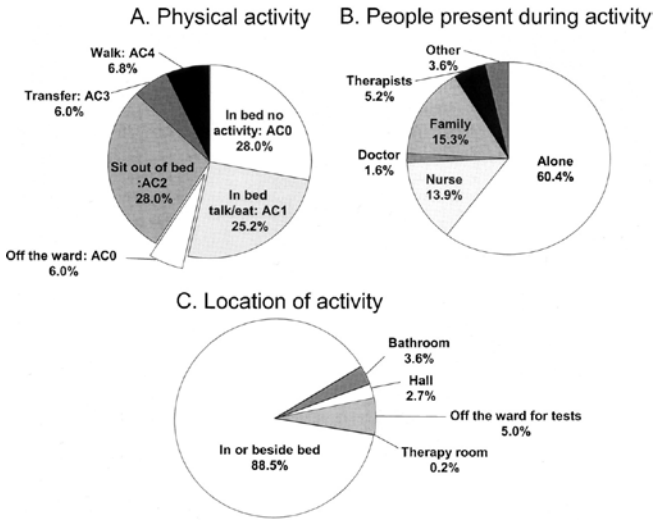

Stroke

Original Contributions

Inactive and Alone

Physical Activity Within the First 14 Days of Acute Stroke Unit Care

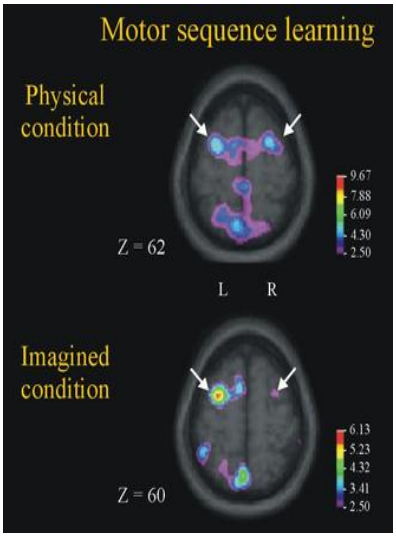
**Figure 1. Physical activity, people present, and location data from observations between 8 am and 5 pm averaged across all cases.**




Bernhardt J et al. Stroke 2004;35:1005-1009

# Mental practice and stroke

- "MP;" "Motor Imagery;" "MI w Mental Practice"
- Same musculature activated during MP as during PP
- Parts of brain are activated during imagery as if actually performing movement
- Repeated practice => brain reorganization => improved motor function
- So, over time, repeated MP use should have a practice effect



Arch Phys Med Rehabil. 2008 Aug;89(8):1580-8. doi: 10.1016/j.apmr.2007.12.039.

**Home-based motor imagery training for gait rehabilitation of people with chronic poststroke hemiparesis.**

Dunsky A, Dickstein R, Marcovitz E, Levy S, Deutsch JE.

- 3 times a week for a total period of 6 weeks, with each session lasting 15 to 20 minutes
- In each patient's home
- Measures:
  - Tinetti Performance-Oriented Mobility Assessment;
  - Patient's self selected cadence, assessed using a metronome
  - 6m walk

Arch Phys Med Rehabil. 2008 Aug;89(8):1580-8. doi: 10.1016/j.apmr.2007.12.039.

**Home-based motor imagery training for gait rehabilitation of people with chronic poststroke hemiparesis.**

Dunsky A, Dickstein R, Marcovitz E, Levy S, Deutsch JE.

- first 4 weeks: push-off performance by the UE and on prolongation of the loading phase of that leg.
- last 2 weeks, subjects were directed to increase their imagined speed and symmetry of walking
  - cadence for imagery training was set through a metronome to coincide with the participant's natural cadence, as determined during assessments

# Mental Practice Intervention

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# Therapy for the affected arm:

- Administered by the same therapists in the same environment (although not at the same time)
- Therapists undergo extensive inservicing (videos, testing, literature review) to assure consistency
- Tasks can be progressed, are B/L, and not necessarily specific to hand dominance

| Tape/CD Number: | Functional Task Described: | When Administered: |
|---|---|---|
| 1 | Reaching for and grasping/drinking from a cup | Weeks 1,2 |
| 2 | Using a push button telephone | Weeks 3,4 |
| 3 | Eating finger foods | Weeks 5,6 |
| 4 | Turning pages | Weeks 7,8 |
| 5 | Playing checkers | Weeks 9,10 |

## Typical mental practice therapy session structure

- 15 minutes – Other activities
  - Will assist with performance of designated functional task
- 15 minutes – Performance of designated functional task with challenge
- 15 minutes – Listening to mental practice recording of designated functional task

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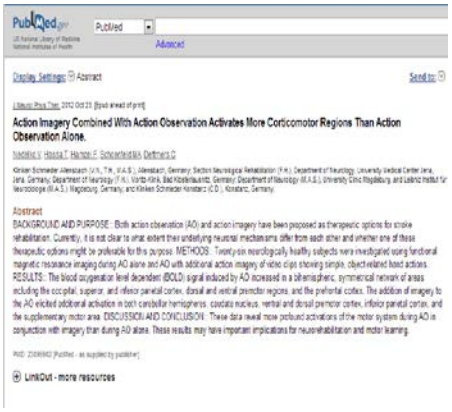
## WHEN?
## Maximize times when you could administer MP, thereby increasing practice attempts

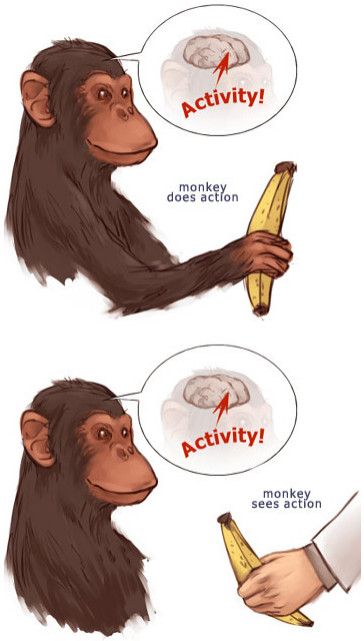
- Home/homework
  - As an alternative to HEP
  - Shortage of clinical practice attempts
  - Develop a library of ADLs
- Internet
- When patient is waiting for tx
- In acute hospital (in bed)

# Multi-modal mental practice (MMMP)




# Mirror neurons- learning by imitation

- Rizzolatti studying monkey brain systems that regulate intentional hand movements.
- Team member reaches for piece of fruit and monkey brain activated.
- The premotor neurons didn't activate at the mere observation of a hand or mouth—only when it was carrying out a **goal directed action**.



- May help with unilateral neglect
- More attention to the affected arm.
- The reflection superimposes normal sensory signals on the affected side.
- This "accurate" information may cause neuroplasticity.

- **Rehabilitation of hemiparesis after stroke with a mirror. Altschuler EL, Wisdom SB, Stone L, Foster C, Galasko D, Llewellyn DM, Ramachandran VS. Lancet. 1999 Jun 12;353(9169):2035-6.**

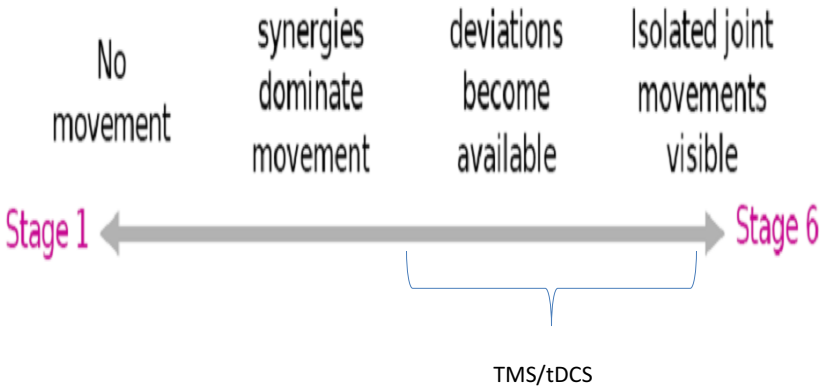
# Mirror therapy

Once daily at least 10 minutes (30 minutes is optimal)

| Motor exercises without an object | Motor exercises with an object |
|---|---|
| Unilateral movements of the non-affected arm only | Unilateral movements of the non-affected arm with an object |
| Bilateral movements ("as good as possible") | Bilateral movements with an object only in the non-affected side |
| Guiding of the affected arm by the therapist | Bilateral movements without objects on both sides (imagining the objects) |
| Guiding of both arms by the therapist | Bilateral movements with guidance of the affected arm by the therapist (with or without an object at the affected side) |

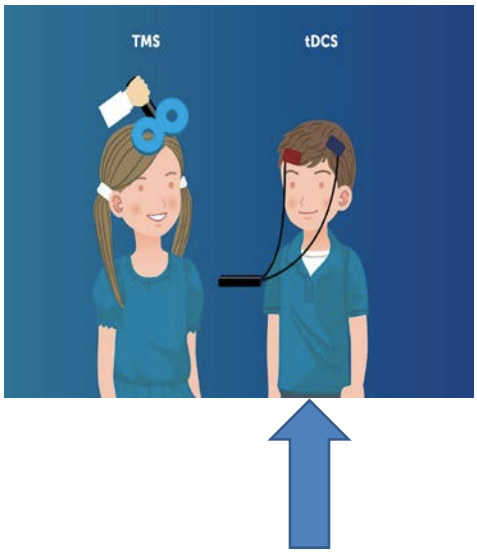
*Mirror Therapy: Practical Protocol for Stroke Rehabilitation (PDF Download Available)*. Available from: https://www.researchgate.net/publication/253235147_Mirror_Therapy_Practical_Protocol_for_Stroke_Rehabilitation [accessed May 29, 2016].

# A review of *some* approaches




## Repetitive transcranial magnetic stimulation: Touching their brains

# transcranial direct current stimulation (tDCS)




- Constant, low current delivered to brain
- Alters resting membrane potential and subsequent neuronal firing
- Expensive
- Big
- Side effects

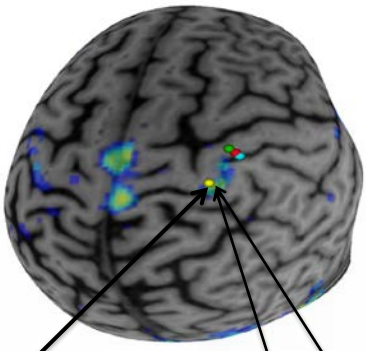
# Device

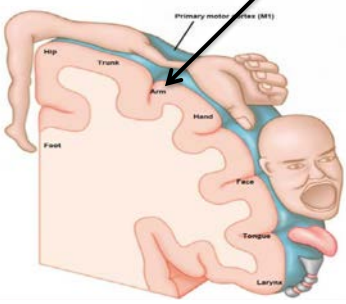
- 1-2mA for 20 minutes
- Dose: 40 mA/min
- Chattanooga Ionto™
- ≈ $400-500

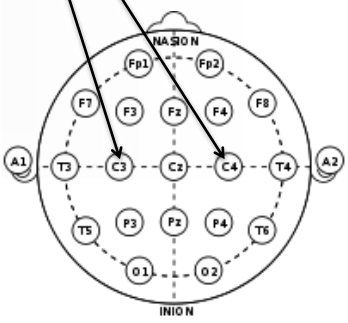
# Functional Brain Stimulation™

- Single dose studies
  - Transient
- Multiple dose
  - Longer term
- Multiple dose + physical practice component
  - Longer term, greater gains
- tDCS overlaid onto task-oriented therapy
- CPT codes:
  - ADL training Neuromuscular Re-ed
  - Gait training

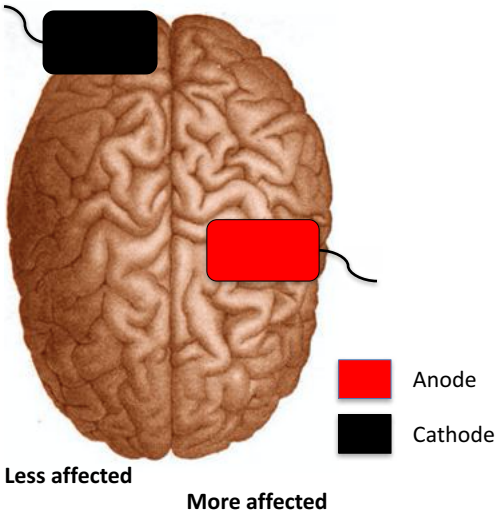

# UE Hemiparesis - Primary Motor Cortex (M1)





# Anodal tDCS




- Increases neuronal excitability & communication of affected area being stimulated
- Long-term potentiation

# What is the impact?

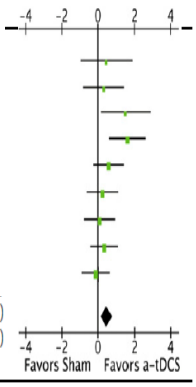
Fixed-effects meta-analysis of seven studies that examined the effects of anodal tDCS vs. sham stimulation on motor function in stroke survivors

| Included studies | Outcome measure | Sham Mean | Sham SD | Sham Total (n) | a-tDCS Mean | a-tDCS SD | a-tDCS Total (n) | Weight (%) | Standard mean difference IV, Fixed (95% CI) |
|---|---|---|---|---|---|---|---|---|---|
| Boggio et al.[9] | JTT | | | | | | | | |
| Fregni et al.[10] | JTT | | | | | | | | |
| Hummel, 2005 | JTT | | | | | | | | |
| Hummel et al.[13] | RT | | | | | | | | |
| Hummel et al.[13] | PS | | | | | | | | |
| Kim et al.[11] | BBT | | | | | | | | |
| Mahmoudi et al.[22] | JTT | | | | | | | | |
| Stagg et al.[14] | RT | 646.27 | 302.94 | 13 | 551.89 | 215.73 | 13 | 16.4 | 0.35 (−0.43, 1.12) |
| Stagg et al.[14] | GS | 1.66 | 1.68 | 13 | 1.47 | 1.4 | 13 | 16.7 | −0.12 (−0.89, 0.65) |
| Total | | | | 84 | | | 84 | 100 | 0.49 (0.18, 0.81) |

PEDro scale results for quality assessment of articles

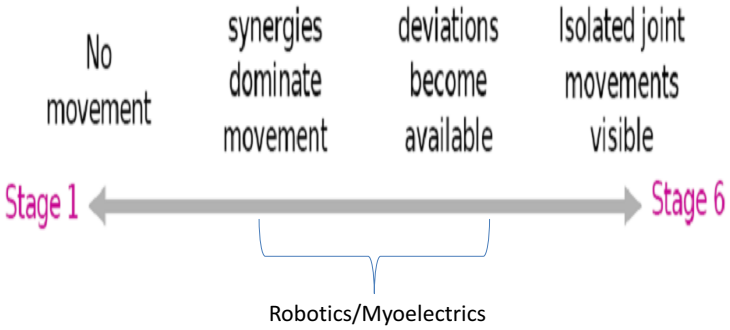
| Included studies | PEDro |
|---|---|
| Boggio et al.[9] | 7 |
| Fregni et al.[10] | 9 |
| Hummel, 2005 | 7 |
| Hummel et al.[13] | 9 |
| Hummel et al.[13] | 7 |
| Kim et al.[11] | 9 |
| Mahmoudi et al.[22] | 8 |
| Stagg et al.[14] | 8 |

Level of evidence: **Level 1a**




Butler et al., 2013; *J Hand Ther*

# A review of *some* approaches




The majority of patients are moderately to severely impaired;
This group commonly exhibits:

- little to no active distal movement;
- min-mod spasticity, co-contraction, reciprocal inhibition
- difficulty w active practice paradigms

# So what do we do with the UE?

- Facilitate *assisted* repetition

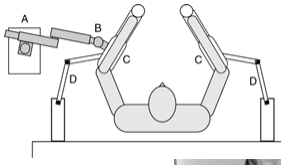
**Rationale:** Functional repetition → Neuroplasticity → Movement

**Benefits:** Spasticity reduction; Motor relearning; Can be done at home by pt and care partners

**Disadvantages:** Requires equipment. But it can be inexpensive equipment.

# How might automated or semi-automated approaches be helpful to this group?

MIT Manus




MIME (mirror Image motion Enabler)

ARM Guide (assisted rehabilitation and measurement)

Are any of these using functional activities?

# The problems:

- Not portable
  - Use in clinics and homes
  - Homes – 70% of therapies do not transfer to homes
- EXPENSIVE
- Negative evidence (in some cases)

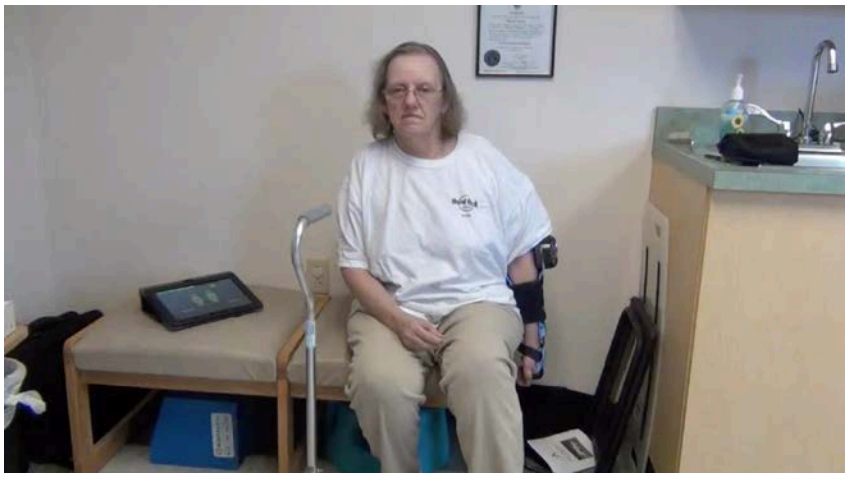
# Myopro-based training

- Portable
- Inexpensive
- Incorporates several, evidence-based strategies in rehab, including:
  - Shaping
  - Repetitive task specific practice for spasticity
  - Repetitive task specific training for learning & Plasticity
  - "Upstream" training
  - Compensation for those who need it

# Specifications

- Weight: 2.75 pounds (1.25 kilograms)
- 7Nm of torque
- 0° to 130°
- Rechargeable Battery


## Phase 1: Volitional Relaxation



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## Bicep Mode During a Very Basic ADL

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## Phase 4: Dual Mode

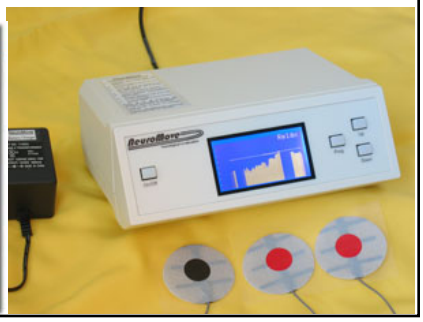
- Increased reciprocal inhibition. Timing may be slow but controlled.
- Biceps and Triceps are starting to work as a team again
- Some people aren't going to get better, so compensation

# Movies

- As a prosthetic

# Types of Devices

- Cyclic
- “Thought” triggered
- EMG-triggered
- Neuroprosthesis
- Implants



# Estim

- Cyclic (Empi et al)
  - Can be integrated into ADLs
  - **Trigger switch**
  - $$ High tens to very low hundreds
- EMG Triggered – not evidence based (EBRSR) but may work on individual pts
  - $$low hundreds
- Bioness
  - Positive evidence for spas reduction
  - $$mid thousands
- Agonist retraining versus Antagonist retraining?

## E-stim Can Be Graded:

Begin repetitive practice paradigms

Get a few degrees of AROM

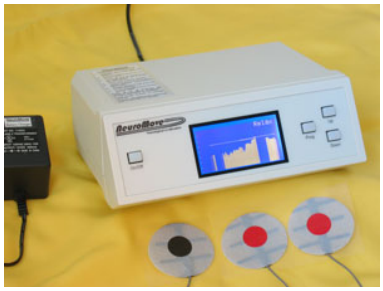
EMG-based estim/functional estim

Get trace movement

Cyclic estim

- What can be done for survivors with spastic paralysis or flaccid paralysis? Estim may be the "missing link."

# EMG-Triggered ES



- How does it work?
  - Set stim intensity and EMG threshold
  - Electrodes sense trace contraction/muscular attempt
  - Device rewards patient with stimulation
  - Begin sequence again…

# Take home points

- A variety of neuro-specific search engines are available
  - All free!
  - Pull as needed
  - Use push regularly (well, actually once)
- Measurement:
  - Communication (pt and team)
  - Reimbursement
  - Efficacy
  - Consider a multi-tiered approach
    - Not all measures will be sensitive to the same deficits and domains
  - We discussed motor in this webinar, BUT motor is affected by:
    - Perceptual
    - Sensory
    - Psychosocial
    - Mobility
    - Pain
    - Other

## Take home points

- We considered approaches, tiered by impairment level.
  - Don't be a "one trick pony;" a single approach does not work with everyone
- Many of the slides had stroke examples, but that's because:
  - More stroke trials out there
  - Higher prevalence disease
- Also applies to ABI, SCI, and, in some cases, neurodegenerative disorders (e.g., MS; Parkinson's)

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National STROKE Association

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- 4 courses culminating in online test
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- Interested? Visit www.strokecertification.com for more information

**Seats are filling quickly!!!**

THE OHIO STATE UNIVERSITY
WEXNER MEDICAL CENTER


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Stephen.Page@osumc.edu