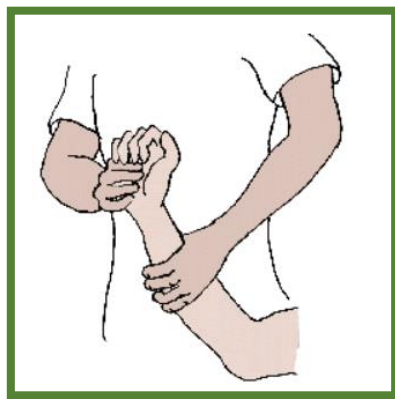


What Can be Learned from Fugl-Meyer Assessment (FMA) & Action Research Arm Test (ARAT)

Loewenstein Rehabilitation Medical Center

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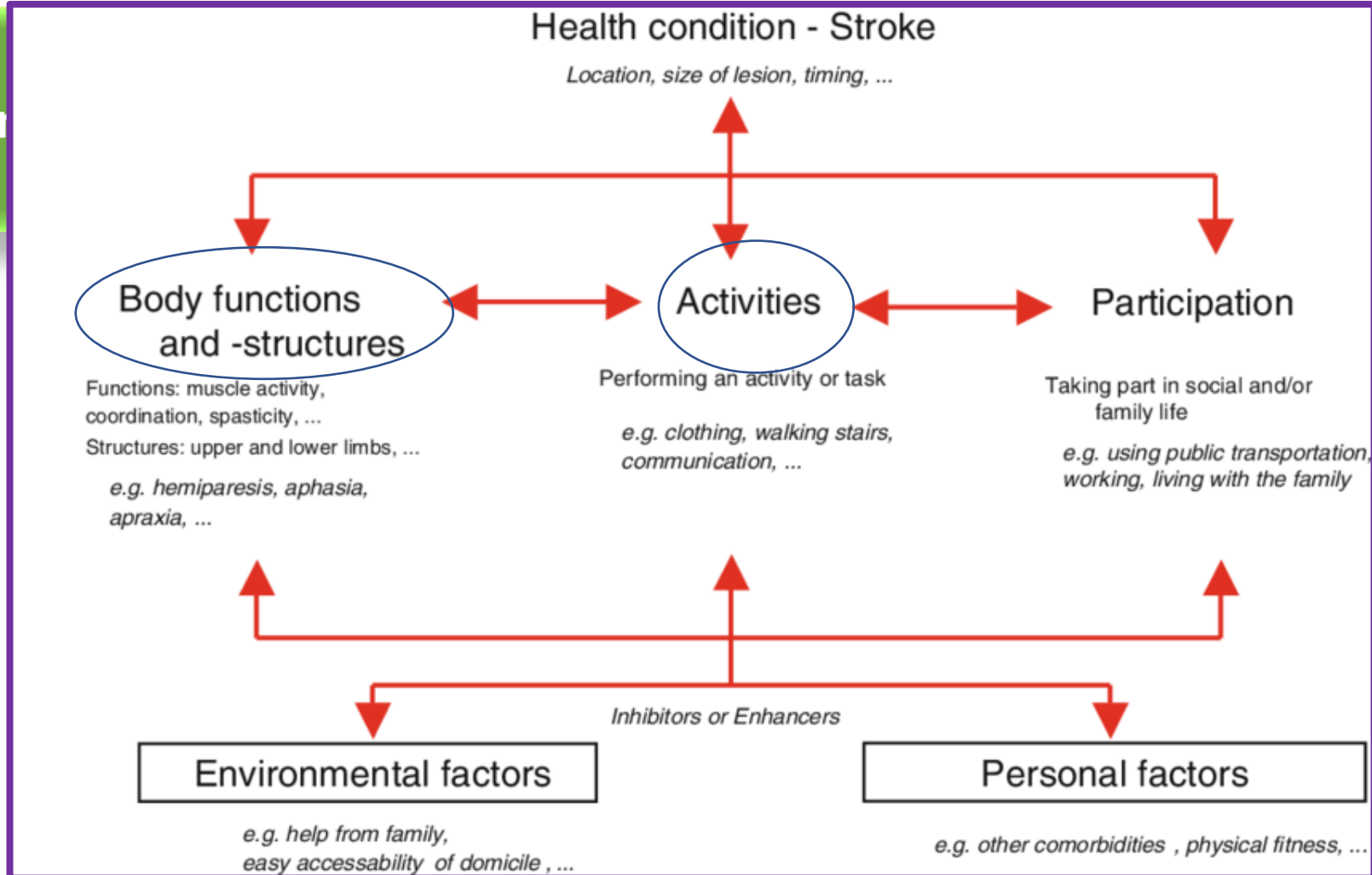


Clinical Assessment of Upper Limb

ICF

Body Function

Activities



Body Functions & Structures

Fugl-Meyer Assessment



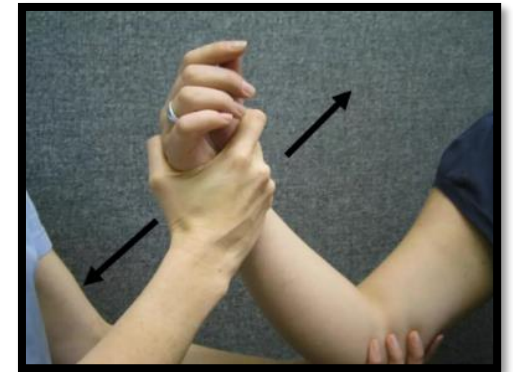
Force



Sensation



Muscle Tone



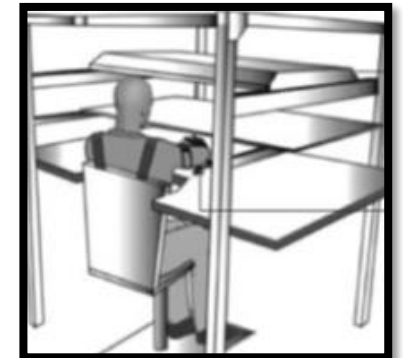
Range of motion



Individuation



Kinematics



Activities

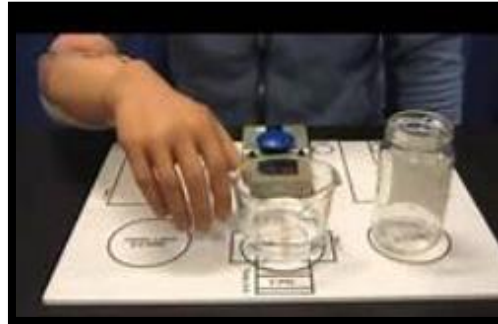
JTHFT

Jebsen - Taylor
Hand Function
Test



WMFT

Wolf Motor
Function Test



ARAT

Action Research
Arm Test



Box & Blocks



Nine Hole Peg



Fu

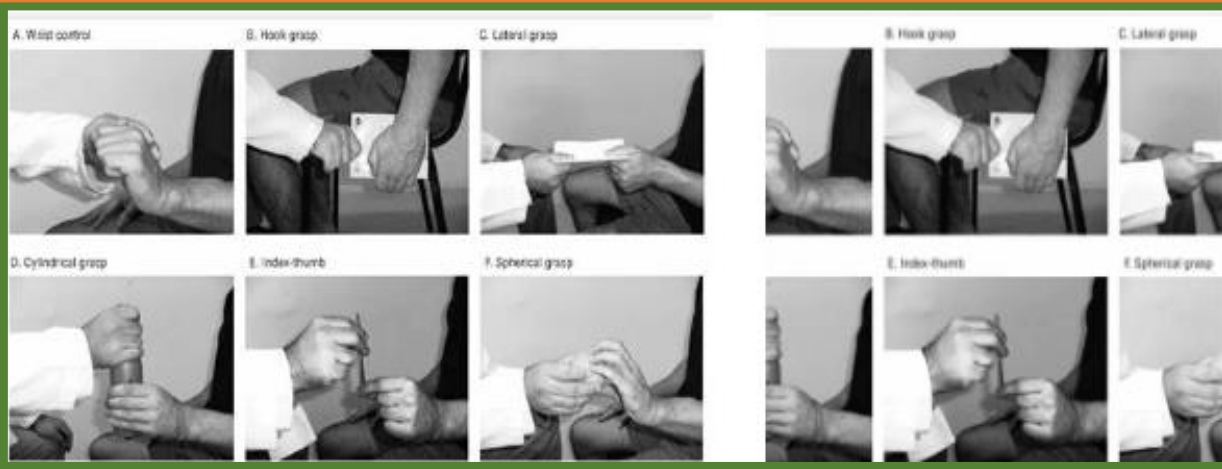
ADAT

Can these measures differentiate between
restitution/recovery and compensation?



Fugl- Meyer Assessment (FMA)

- ✓ Fugl-Meyer Assessment (FMA) of physical performance was devised in 1975 to assess impairment after stroke (Fugl-Meyer et al. 1975)
- ✓ The motor section tests the ability to isolate and control joints outside flexor & extensor synergies 
- ✓ The movements tested are not related to functional tasks
- ✓ Rarely used today in clinical practice

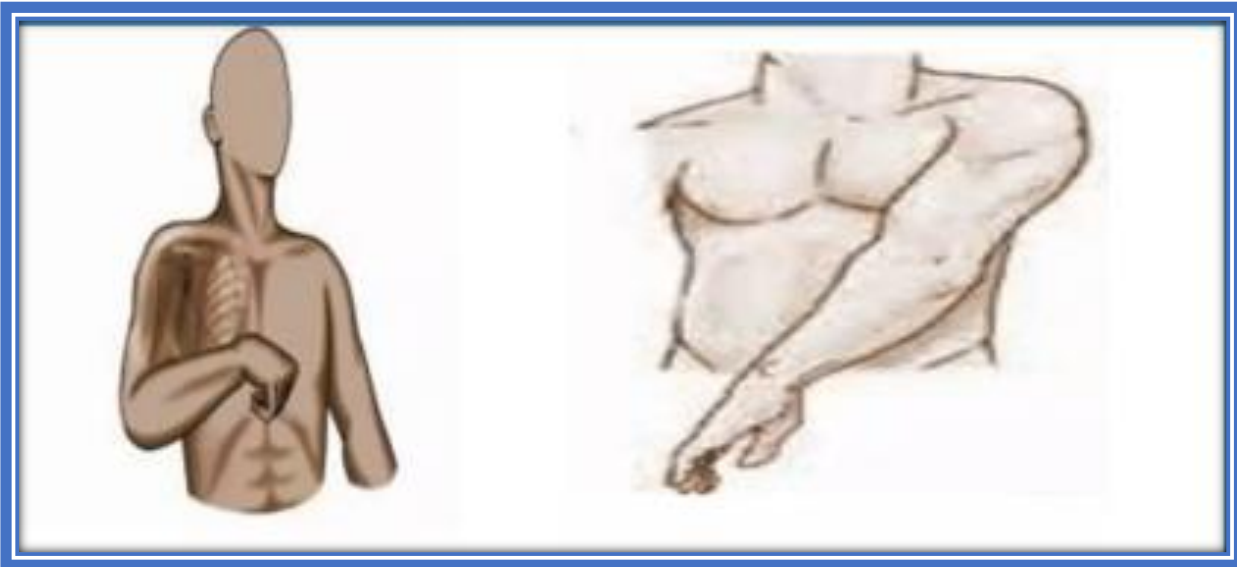


Fugl-Meyer et al., 1975; Duncan et al. 2000;
Gladstone et al. 2002

Synergies

Pathological synergies

Stereotypical activation of muscles or coarticulation of multiple joints during attempted behavior



Physiological synergies

planning and control of normal movements



Fugl- Meyer Assessment of Upper Extremity (FMA)

Divided into 4 sub-tests

Motor Function

Sensory
Function

Joint Range of
Motion

Joint Pain

✓ Upper extremity maximum score =66

FMA Score:

Severe: 25 or below

Moderate: 26 to 45

Mild: 46 to 66

(Duncan et al. 2000; Gladstone et al. 2002)

✓ sensitive, reliable and valid (Duncan et al., 1983; Platz et al., 2005)

✓ Minimal detectable change (MDC)= 5.2 points

Performance is rated on a 3 point ordinal scale ranging from:

2. performs fully

1. performs partially

0. cannot perform

A. Upper Extremity

A. UPPER EXTREMITY, sitting position					
I. Reflex activity			none	can be elicited	
Flexors: biceps and finger flexors (at least one)			0	2	
Extensors: triceps			0	2	
Subtotal I (max 4)					
II. Volitional movement within synergies, without gravitational help			none	partial	full
Flexor synergy: Hand from contralateral knee to ipsilateral ear. From extensor synergy (shoulder adduction/ internal rotation, elbow extension, forearm pronation) to flexor synergy (shoulder abduction/ external rotation, elbow flexion, forearm supination). Extensor synergy: Hand from ipsilateral ear to the contralateral knee	Shoulder	retraction	0	1	2
		elevation	0	1	2
		abduction (90°)	0	1	2
		external rotation	0	1	2
	Elbow	flexion	0	1	2
	Forearm	supination	0	1	2
	Shoulder	adduction/internal rotation	0	1	2
	Elbow	extension	0	1	2
	Forearm	pronation	0	1	2
Subtotal II (max 18)					
III. Volitional movement mixing synergies, without compensation			none	partial	full
Hand to lumbar spine	cannot perform or hand in front of ant-sup iliac spine	0	1	2	
hand on lap	hand behind ant-sup iliac spine (without compensation)				
	hand to lumbar spine (without compensation)				
Shoulder flexion 0°- 90°	immediate abduction or elbow flexion	0	1	2	
elbow at 0°	abduction or elbow flexion during movement				
pronation-supination 0°	flexion 90°, no shoulder abduction or elbow flexion				
Pronation-supination	no pronation/supination, starting position impossible	0	1	2	
elbow at 90°	limited pronation/supination, maintains starting position				
shoulder at 0°	full pronation/supination, maintains starting position				
Subtotal III (max 6)					

IV. Volitional movement with little or no synergy		none	partial	full
Shoulder abduction 0 - 90° elbow at 0° forearm pronated	immediate supination or elbow flexion supination or elbow flexion during movement abduction 90°, maintains extension and pronation	0	1	2
Shoulder flexion 90° - 180° elbow at 0° pronation-supination 0°	immediate abduction or elbow flexion abduction or elbow flexion during movement flexion 180°, no shoulder abduction or elbow flexion	0	1	2
Pronation/supination elbow at 0° shoulder at 30°- 90° flexion	no pronation/supination, starting position impossible limited pronation/supination, maintains start position full pronation/supination, maintains starting position	0	1	2
Subtotal IV (max 6)				
V. Normal reflex activity assessed only if full score of 6 points is achieved in part IV; compare with the unaffected side		0 (IV), hyper	lively	normal
biceps, triceps, finger flexors	2 of 3 reflexes markedly hyperactive or 0 points in part IV 1 reflex markedly hyperactive or at least 2 reflexes lively maximum of 1 reflex lively, none hyperactive	0	1	2
Subtotal V (max 2)				
Total A (max 36)				

B. Wrist & C. Hand

B. WRIST support may be provided at the elbow to take or hold the starting position, no support at wrist, check the passive range of motion prior testing		none	partial	full
Stability at 15° dorsiflexion elbow at 90°, forearm pronated shoulder at 0°	less than 15° active dorsiflexion dorsiflexion 15°, no resistance tolerated maintains dorsiflexion against resistance	0	1	2
Repeated dorsiflexion / volar flexion elbow at 90°, forearm pronated shoulder at 0°, slight finger flexion	cannot perform volitionally limited active range of motion full active range of motion, smoothly	0	1	2
Stability at 15° dorsiflexion elbow at 0°, forearm pronated slight shoulder flexion/abduction	less than 15° active dorsiflexion dorsiflexion 15°, no resistance tolerated maintains dorsiflexion against resistance	0	1	2
Repeated dorsiflexion / volar flexion elbow at 0°, forearm pronated slight shoulder flexion/abduction	cannot perform volitionally limited active range of motion full active range of motion, smoothly	0	1	2
Circumduction elbow at 90°, forearm pronated shoulder at 0°	cannot perform volitionally jerky movement or incomplete complete and smooth circumduction	0	1	2
Total B (max 10)				
C. HAND support may be provided at the elbow to keep 90° flexion, no support at the wrist, compare with unaffected hand, the objects are interposed, active grasp		none	partial	full
Mass flexion from full active or passive extension		0	1	2
Mass extension from full active or passive flexion		0	1	2
GRASP				
a. Hook grasp flexion in PIP and DIP (digits II-V), extension in MCP II-V	cannot be performed can hold position but weak maintains position against resistance	0	1	2
b. Thumb adduction 1-st CMC, MCP, IP at 0°, scrap of paper between thumb and 2-nd MCP joint	cannot be performed can hold paper but not against tug can hold paper against a tug	0	1	2
c. Pincer grasp, opposition pulpa of the thumb against the pulpa of 2-nd finger, pencil, tug upward	cannot be performed can hold pencil but not against tug can hold pencil against a tug	0	1	2
d. Cylinder grasp cylinder shaped object (small can) tug upward, opposition of thumb and fingers	cannot be performed can hold cylinder but not against tug can hold cylinder against a tug	0	1	2
e. Spherical grasp fingers in abduction/flexion, thumb opposed, tennis ball, tug away	cannot be performed can hold ball but not against tug can hold ball against a tug	0	1	2
Total C (max 14)				

D. Coordination/Speed

D. COORDINATION/SPEED , sitting, after one trial with both arms, eyes closed, tip of the index finger from knee to nose, 5 times as fast as possible		marked	slight	none
Tremor	at least 1 completed movement	0	1	2
Dysmetria at least 1 completed movement	pronounced or unsystematic slight and systematic no dysmetria	0	1	2
		≥ 6s	2 - 5s	< 2s
Time start and end with the hand on the knee	at least 6 seconds slower than unaffected side 2-5 seconds slower than unaffected side less than 2 seconds difference	0	1	2
Total D (max 6)				

A. UPPER EXTREMITY	/36
B. WRIST	/10
C. HAND	/14
D. COORDINATION / SPEED	/ 6
TOTAL A-D (motor function)	/66

Action Research Action Test - ARAT

- ✓ Assesses upper limb functioning using observational methods (Lyle 1981)
- ✓ Stroke, TBI, MS
- ✓ High reliability and validity
- ✓ Scoring takes into account quality of coordination, time taken & task completion



Rabadi & Rabadi 2006; Nijland et al. 2010

Action Research Action Test - ARAT

Divided into 4 sub-tests

Grasp

Grip

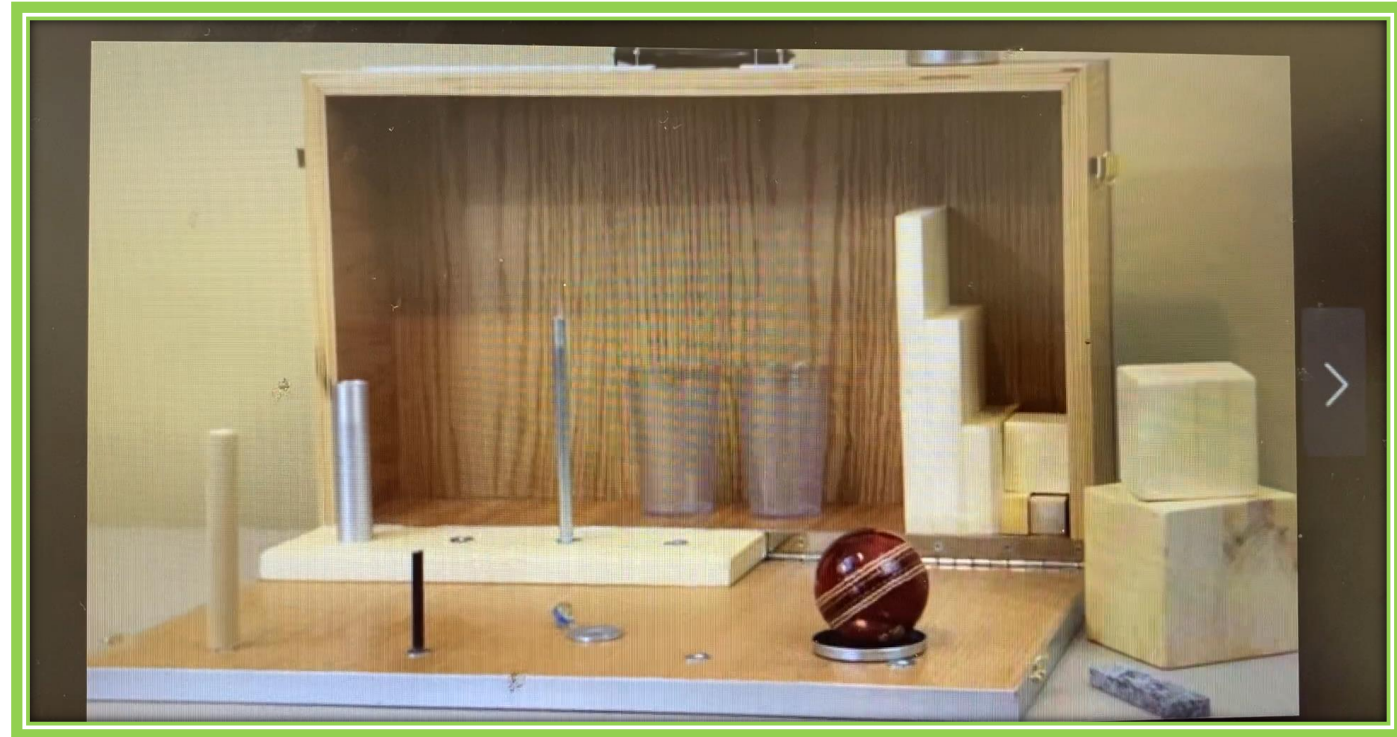
Pinch

Gross hand movements

19 items

Maximum score=57

Minimal detectable
change (MDC)= 3.5 points



Action Research Action Test - ARAT

Performance is rated on a 4-point ordinal scale ranging from:

- 3. Performs test normally. 5 sec. Normal movement's component
- 2. Completes test, but takes long or has great difficulty, 5-60 sec.
- 1. Performs test partially, within 60 sec.
- 0. Can perform no part of test, within 60 sec.

ARAT Score:

50-57 potential to use hand

34-48 potential to use hand for most ADL activities with weakness, slowness, or clumsiness

13-31 potential to regain some movement, unlikely to regain dexterous function

0-9 unlikely to regain useful hand function

TEST #	GRASP SUBSCALE	TASK / TARGET
1	10cm BLOCK	DISPLACE VERTICALLY TO SHELF
2	2.5cm BLOCK	DISPLACE VERTICALLY TO SHELF
3	5cm BLOCK	DISPLACE VERTICALLY TO SHELF
4	7.5cm BLOCK	DISPLACE VERTICALLY TO SHELF
5	CRICKET BALL	
6	STONE	

Lyle's decision rules:

1. Achievement of max. score on first item → full subset score
2. A score of less than 3 on first item → second item assessed
3. If scored 0 → other items are scored 0

GRIP

7	TUMBLERS	
8	2.5cm (WID)	
9	1.0cm (THIN)	
10	WASHER	DISPLACE DISTALLY FROM LINED TIN TO TALL GREEN BOLT

PINCH SUBSCALE

11	BALL BEARING	BETWEEN RING FINGER AND THUMB FROM TIN TO SHELF
12	MARBLE	BETWEEN INDEX FINGER AND THUMB FROM TIN TO SHELF
13	BALL BEARING	BETWEEN MIDDLE FINGER AND THUMB FROM TIN TO SHELF
14	BALL BEARING	BETWEEN INDEX FINGER AND THUMB FROM TIN TO SHELF
15	MARBLE	BETWEEN RING FINGER AND THUMB FROM TIN TO SHELF
16	MARBLE	BETWEEN MIDDLE FINGER AND THUMB FROM TIN TO SHELF

GROSS MOVEMENTS

17	HAND BEHIND HEAD
18	HAND TO TOP OF HEAD
19	HAND TO MOUTH

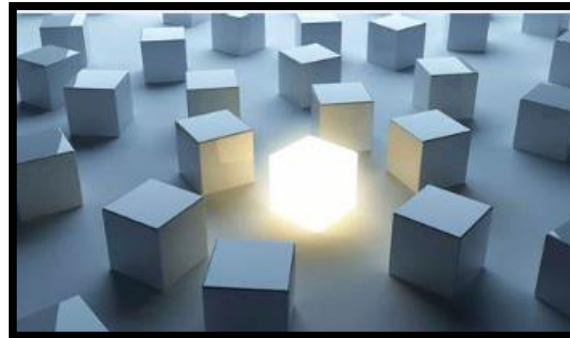
RIGHT

0	1	2	3	0	1	2	3
0	1	2	3	0	1	2	3
0	1	2	3	0	1	2	3
0	1	2	3	0	1	2	3
0	1	2	3	0	1	2	3
0	1	2	3	0	1	2	3
Subtotal...../18				/18			

ITEM #	TASK COMPONENTS	KEY COMPETENCIES	
		Hand Movements	Arm Movements
1 - 4	BLOCKS: TABLE TO SHELF	Hand voluntarily opens to the size of the block. Any type of grasp involving thumb & fingers in opposition.	(a) Forearm is between mid-position & pronation.
5	CRICKET BALL: TABLE TO SHELF	Spherical grasp with fingers and thumb slightly flexed and abducted to the size of the ball.	(b) Elbow flexed when first grasping object then extends to reach the top of the shelf.
6	STONE: TABLE TO SHELF	Lateral grip: stone held 'twixt pad of thumb & radial side of index finger at or near interphalangeal joints.	(c) Shoulder flexion to reach top of shelf & shoulder stabilization to hold position as object released.
7	POUR WATER FROM TUMBLER	Cylindrical grasp around tumbler.	(d) Thumb & finger extension to release the object.
8 - 9	TUBES TO TARGET POINT	Any grasp (eg. 3 jaw chuck pinch) involving the pads of the thumb opposed with pads of any number of digits in a successful grasp of the tube.	(a) Forearm between mid-position and pronation.
10	WASHER FROM TIN TO TARGET	Pincer or 3 jaw chuck pinch with thumb & finger pads in opposition in order to grasp the washer.	(b) Elbow extends sufficiently to reach target.
11,13,14	BALL BEARING: TIN TO SHELF	Opposition of pads of ring, middle and index finger with thumb respectively.	(c) Shoulder movement & stabilization to maintain position as object is released.
12,15,16	MARBLE: TIN TO SHELF	Opposition of pads of index, ring and middle finger with thumb respectively.	(d) Thumb & finger extension to release the object.
17 - 19	HAND FROM LAP TO HEAD	Palm side of hand (hand does not have to be open) reaches to back and top of head and mouth.	(a) Forearm between mid-position and pronation.
			(b) Elbow flexed when first grasping object then extends to reach top of shelf.
			(c) Shoulder flexion to reach top of shelf & shoulder stabilization to hold position as object released.
			(a) Forearm pronation and supination.
			(b) Full elbow flexion.
			(c) Shoulder abduction, flexion & external rotation.

Can these measures differentiate between restitution/recovery and compensation?

FMA



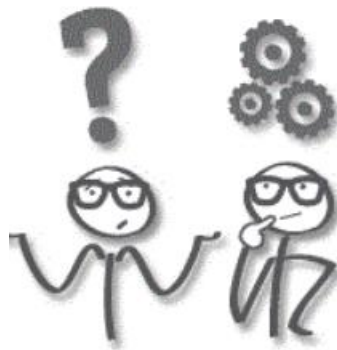
ARAT

FMA

- ✓ Compensation reduces score
- ✓ Largely immune to compensation (Cortes et al. 2017)



Measures recovery



ARAT

- ✓ Some items can be performed using compensatory techniques
- ✓ Compensation doesn't reduce score in all items
- ✓ Items requiring fine motor ability can't be performed using compensatory techniques



Measures recovery + improved function

Some points to think about

FMA

- ✓ Subject to ceiling effects for patients with very mild impairment
- ✓ Finger individuation and precision grip are minimally tested
- ✓ Recovery of distal fine motor function underrepresented

ARAT

- ✓ Doesn't take into account all aspects of motor control
- ✓ Subject to ceiling effects for patients with very mild impairment
- ✓ Subject to floor effects for patients with very Severe impairment

Body Functions & Structures

Recovery

Measuring should not be influenced by compensation



Activities

Improved function

Scoring is sensitive to restitution and compensation

