acpin
Connecting knowledge and practice

UNIVERSITY OF Southampton

Application of neuroscience to neurological physical therapy

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Dansk Selskab for Neurologisk Fysioterapi

Take Home Message

As a therapist you ask:

'What does my patient want to achieve?'

But should you also ask:

'What neurological impairment am I treating?'

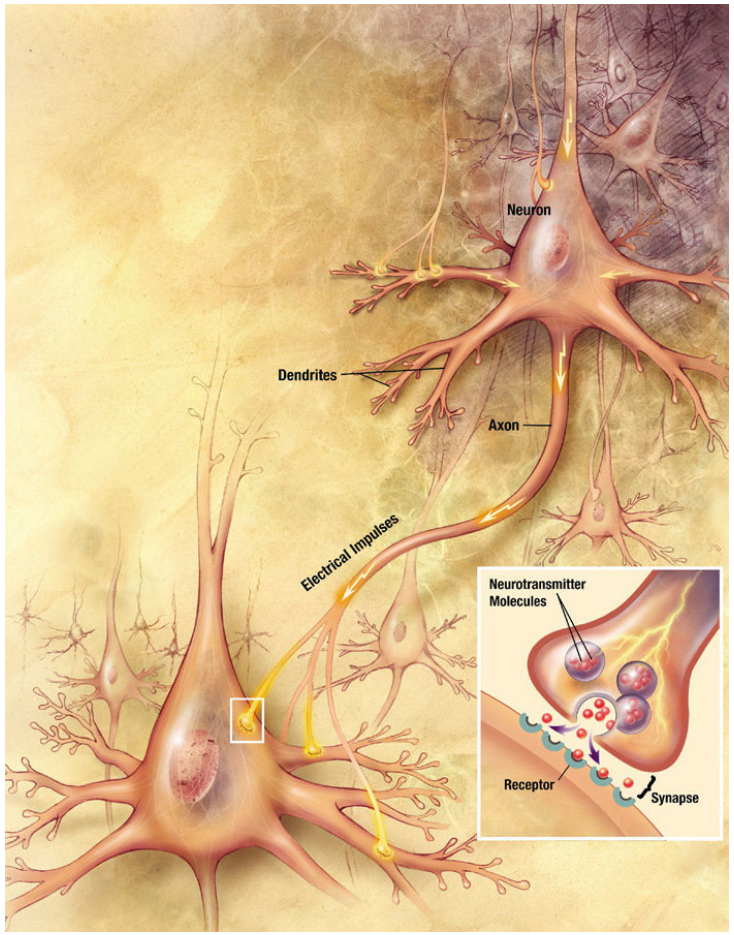
'What neurological change am I expecting?'

Overview

- The underpinnings of neurological physical therapy
- Understanding functional recovery
- Evidence and how to use it

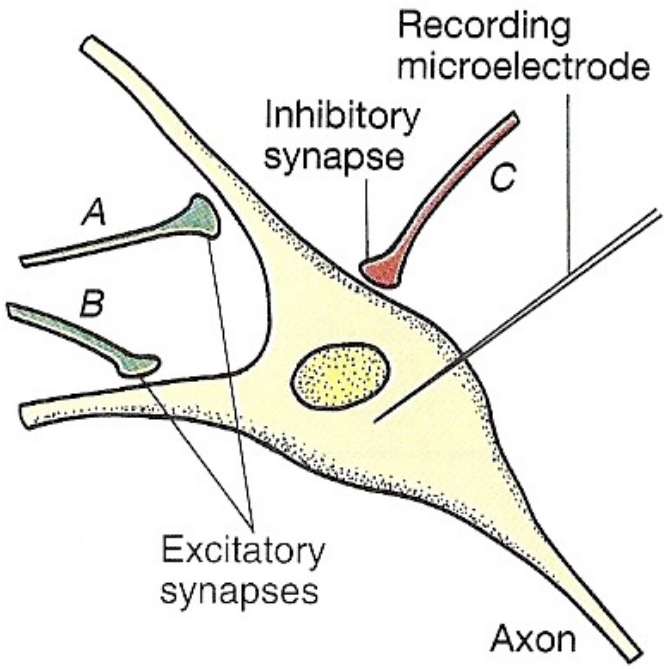
The underpinnings of neurological physical therapy

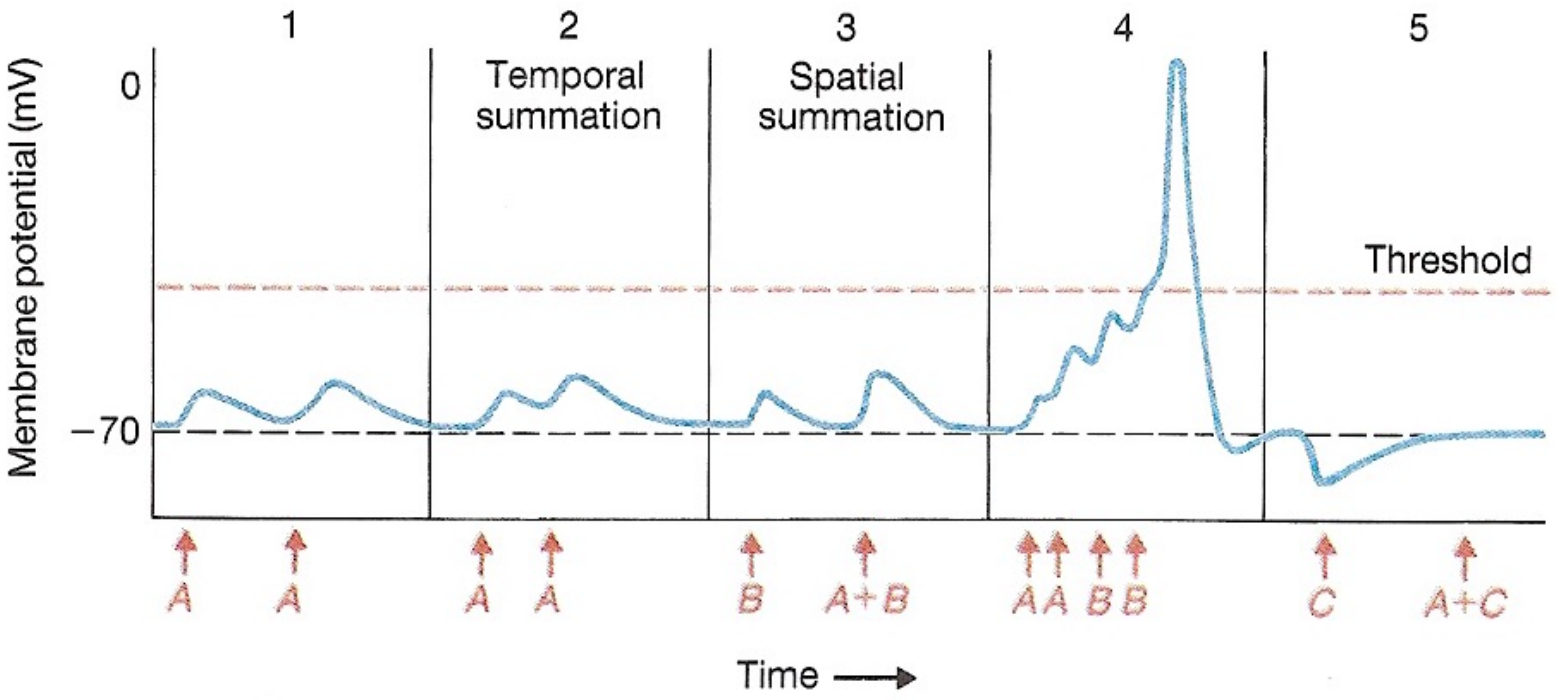
Neuroplasticity: physiology - the synapse - communication between nerves



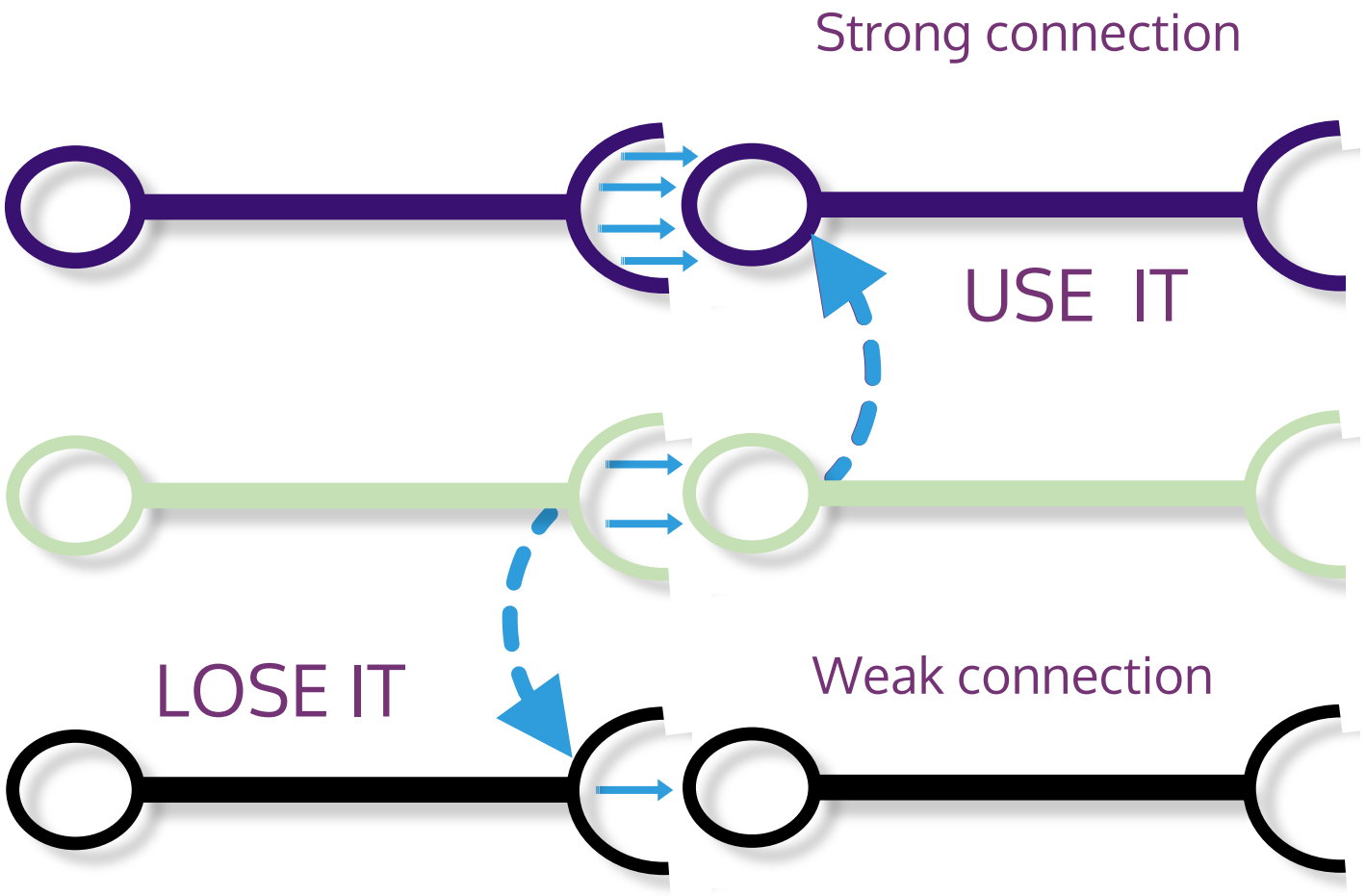
- 100 Billion nerve cells
- 1,000 Trillion connections
- Everyday 5% connections are lost and 5% are formed
- That enables us to learn
- Excitatory / inhibitory
- Summation

What determines whether a cell fires?



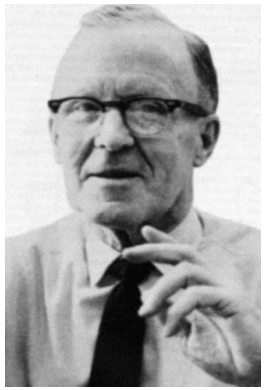


Neuroplasticity is key to recovery

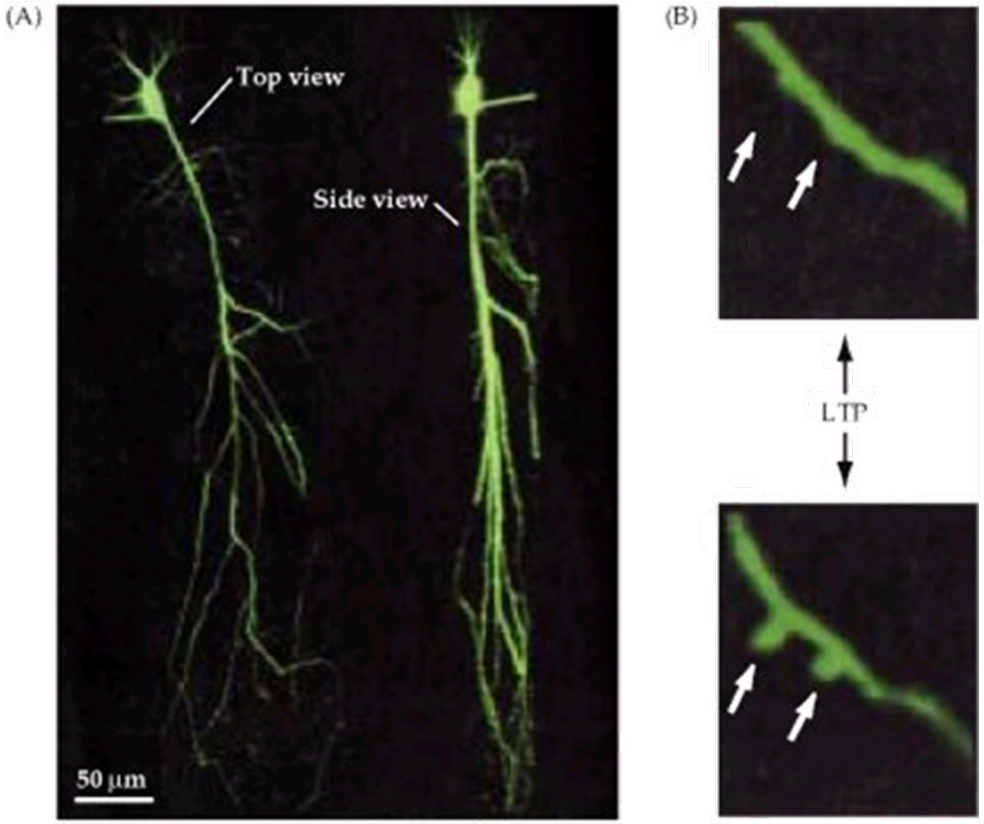


Adapted from Nick Ward's Amazing Brains Stroke Association Royal Lecture 2019

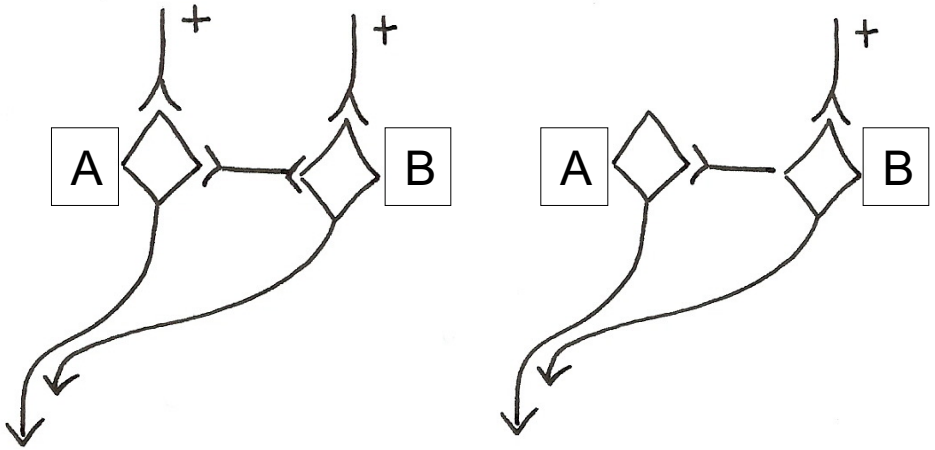
Donald Hebb (1904–1985)



New post-synaptic dendrite spines appearing one hour after stimulation – accompanying synaptic efficiency



Engert & Bonhoeffer, Nature. 1999



Fire together – wire together'

Hebbian Learning

Repetitive activation of a presynaptic neuron together with simultaneous activation of a neighbouring postsynaptic neuron leads to an increase in synaptic strength between them.

Substantiated by experimental evidence and underpins LTP and LTD

Is there evidence to support ‘increased dose’?

- In (human) stroke rehabilitation the typical number of repetitions in a session is 30 *(Lang et al, 2009)*
- In animals, changes in primary motor cortex synaptic density occur after 400 (but not 60) reaches *(Remple et al, 2001)*
- Might there be a ‘threshold’ above which UL use improves and below which it decreases *(Schweighofer et al, 2009)*
- Can the number be increased by providing other support to enable movement or giving motivating feedback?

Summary of the physiology of neuroplasticity

- Changes in sensitivity to neurotransmitters
- Strengthening / weakening of existing synapses
- Formation of new synapses / loss of existing ones
- Axon sprouting
- ….Changes in the cortical map

Engert & Bonhoeffer, Nature. 1999

Neuroplasticity: behavioural level – types of learning

- Associative learning – reward, pleasure, pain – Pavlov's dog
- Non-associative learning – reflex – habituation / sensitisation
- Declarative or explicit memory / learning (consciously aware of remembering e.g. facts) learning may be v. rapid
- Non-declarative or implicit memory / learning – motor skills (demonstrated by 'doing')
- Therapists often use explicit learning in training motor skills
- Evidence suggests this may not be effective (12,13)

Stages in motor learning and skill acquisition

- Early cognitive phase (declarative phase – explicit)
- Intermediate phase – trial and error (implicit and explicit learning)
- Late autonomous phase (procedural learning)

Skill acquisition: Implicit and Explicit learning

- Explicit learning:
  - ‘How to’ – associated with memory, cognition etc.
  - Learning may be very rapid and is tested by questioning
- Implicit learning:
  - Motor skills are examples of implicit learning
  - Demonstrated by ‘doing’
- Therapists often use explicit learning in training motor skills
- Evidence suggests this may not be effective:

- Durham K et al. Use of information feedback and attentional focus of feedback in treating the person with a hemiplegic arm. *Physiother Res Int.* 2008;14:77–90.
- Johnson, L., Burridge, J. H. and Demain, S. H. (2013) 'Internal and external focus of attention during gait re-education: an observational study of physical therapist practice in stroke rehabilitation', *Physical therapy,* 93(7), pp. 957-966.

External focus and Internal focus tasks

Task	External	Internal
Straighten your knee as you take weight on that leg		
Look at the clock as you walk down the corridor		
Pick up the box on the table and put it on the shelf		
When you stand-up think about bringing your weight forwards over your feet		
When you transfer your weight onto your hemiplegic leg, feel the weight going through your hip		
Stand-up and reach forward to touch my hand		

External focus and Internal focus tasks

Task	External	Internal
Straighten your knee as you take weight on that leg		X
Look at the clock as you walk down the corridor		
Pick up the box on the table and put it on the shelf		
When you stand-up think about bringing your weight forwards over your feet		
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Stand-up and reach forward to touch my hand		

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Stand-up and reach forward to touch my hand	X	

Understanding functional recovery

FORM follows FUNCTION

Useful neuroplastic changes – avoidance of spasticity & 2nd changes (FUNCTION)

Return to more Normal neural structures (FORM)

Activities / interventions that promote more **normal** motor behaviours

CNS damage resulting in abnormal motor behaviours

Reinforcement of Abnormal Neural Structures (FORM)

Activities / interventions that promote more **abnormal** motor behaviours

Maladaptive Neuroplastic Changes – spasticity (FUNCTION)

What is the difference between recovery (behavioural restitution) and compensation?

- *Recovery:* the reappearance of elemental motor patterns present prior to central nervous system injury
  - Assessed by quality of movement and neuroimaging
- *Compensation:* the appearance of new motor patterns resulting from the adaptation of remaining motor elements
  - Assessed by functional activity

Levin MF et al. What Do Motor "Recovery" and "Compensation" Mean in Patients Following Stroke? *Neurorehabilitation and Neural Repair*. 2009;23(4):313-319. doi:10.1177/1545968308328727

Changes in the nervous system underpin changes in behaviour

Neural restitution + Neuronal substitution

Behavioural restitution

(QoM e.g., smoothness, muscle synergies

Behavioural compensation

(i.e., achievement of functional tasks)

repair

adaptation

>90% within 5-8 weeks

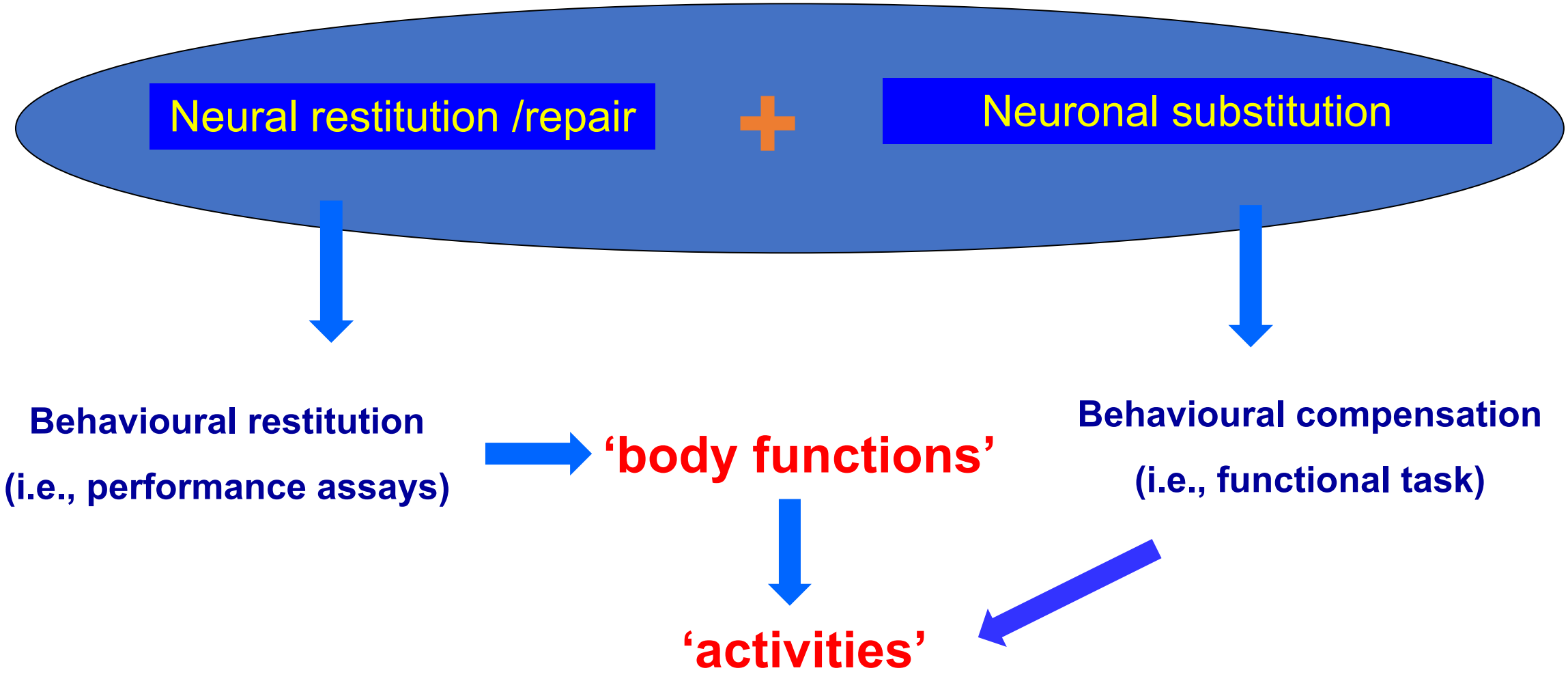
QoM

(Return to normal / healthy behaviour)

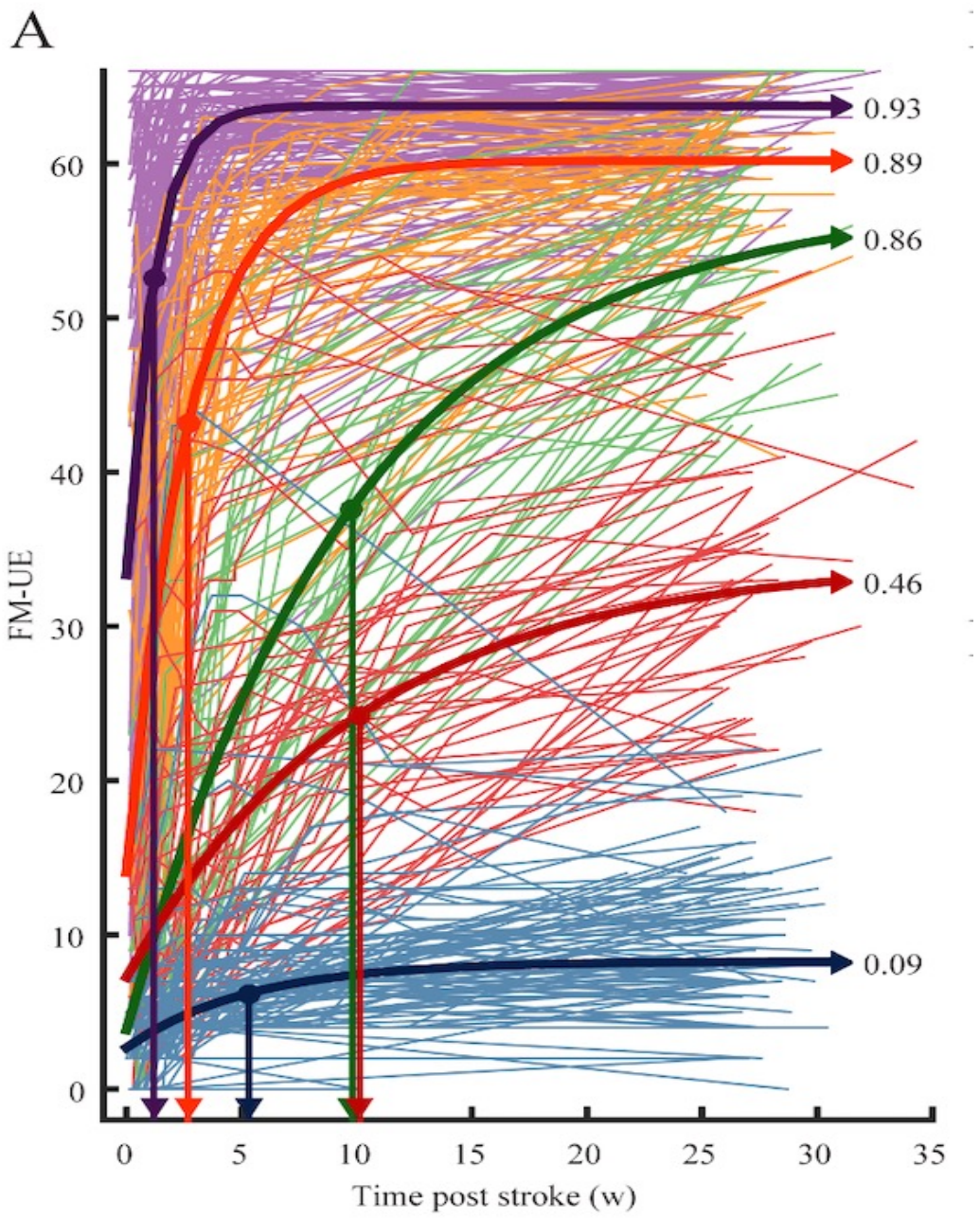
Need for longitudinal studies

Slide adapted with acknowledgement to Gert Kwakkel

Assessment - applying the ICF framework



Slide courtesy of Gert Kwakkel



- Mean recovery profile predicted by baseline score
- But with individual variation
- Improvement in FM-UE at 10 weeks identifies patients who have not plateaued
- And might experience restitution
- Therapy for these patients should target normal movement patterns (restitution)
- Patients who have a low score and have plateaued at 10 weeks may benefit more from therapy targeting functional activities, even if using abnormal movement patterns (compensation)
- When should patients be recruited to trials – receive intensive rehab?

So..

- Skill acquisition post stroke is likely to be through a combination neural recovery and behavioural compensation
  - Initial level of impairment is the best predictor
  - But individual recovery profiles vary
  - And are important for deciding treatment aims
- Measurement of quality of movement provides data on restitution
  - kinematic and kinetic
  - Impairment not activity
- We need a better understanding the neural repair process
- And the potential for recovery which is important for:
  - Focus of treatment
  - Screening for trials

Treatment Aims

- Treatment targeting recovery aims for normal movement patterns and follows motor learning principles
- Treatment targeting compensation focuses on achieving function, independence and safe mobility goals
- Personalised treatment demands that we treat patients differently at different stages post-stroke dependent on their needs
- Including their predicted recovery

Why is assessment important?

- Clinical reasons:
  - To understand the individual patient's problems
  - To decide on how to solve them – clinical reasoning
  - To measure progress and revise treatment plans
- Research-orientated reasons – understand:
  - The problem
  - The effect of the intervention
  - Why a person did or did not get better
- Standardised movement outcome measures and protocols:
  - Inform treatment
  - Allow pooling of data
  - Understand recovery profiles

International Journal of Stroke WSO

International Journal of Stroke
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2nd SRRR | Stroke Recovery and Rehabilitation Roundtable

Standardized measurement of quality of upper limb movement after stroke: Consensus-based core recommendations from the Second Stroke Recovery and Rehabilitation Roundtable

G Kwakkel[1], EEH Van Wegen[2], JH Burridge[3], CJ Winstein[4], LEH van Dokkum[5], M Alt Murphy[6], MF Levin[7] and JW Krakauer[8]; on behalf of the ADVISORY group

Core and Advisory Groups

Gert Kwakkel Netherlands

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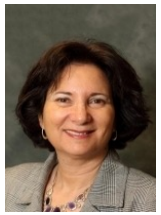

Mindy Levin, Canada

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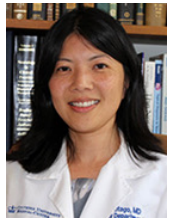
Carolee Winstein, USA

Liesjet van Dokkum



Tomoko Kitago, USA

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Thierry Keller Spain

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Kwakkel G, van Wegen EEH, Burridge JH, Winstein CJ, van Dokkum LEH, Alt Murphy M, Levin MF, Krakauer JW; ADVISORY group. Standardized Measurement of Quality of Upper Limb Movement After Stroke: Consensus-Based Core Recommendations From the Second Stroke Recovery and Rehabilitation Roundtable. Neurorehabil Neural Repair. 2019 Nov;33(11):951-958. doi: 10.1177/1545968319886477. Epub 2019 Oct 29. PMID: 31660781.

Stroke Recovery and Rehabilitation Roundtable (SRRR)

Purpose: An international collaboration to create a pathway to accelerate development and implementation of breakthrough treatments for stroke recovery

SRRR1*

Enhancing alignment preclinical and clinical pipeline

Biomarkers of recovery; motor, sensation, language and cognition

Development, monitoring and reporting of stroke rehabilitation research

Standardised measurement of sensorimotor recovery

Identified gaps

SRRR2

Cognitive impairment after stroke

Standardised measurement of **quality of upper limb movement**

Improving how we **develop recovery trials**

Moving knowledge into practice

Leverage momentum

ISRRA

- To create a 'go-to' place for researchers interested in recovery
- Identify funding priorities for stroke recovery research
- Create working groups that continue to drive momentum to support the stated purpose and goals
- Identify new targets for consensus building

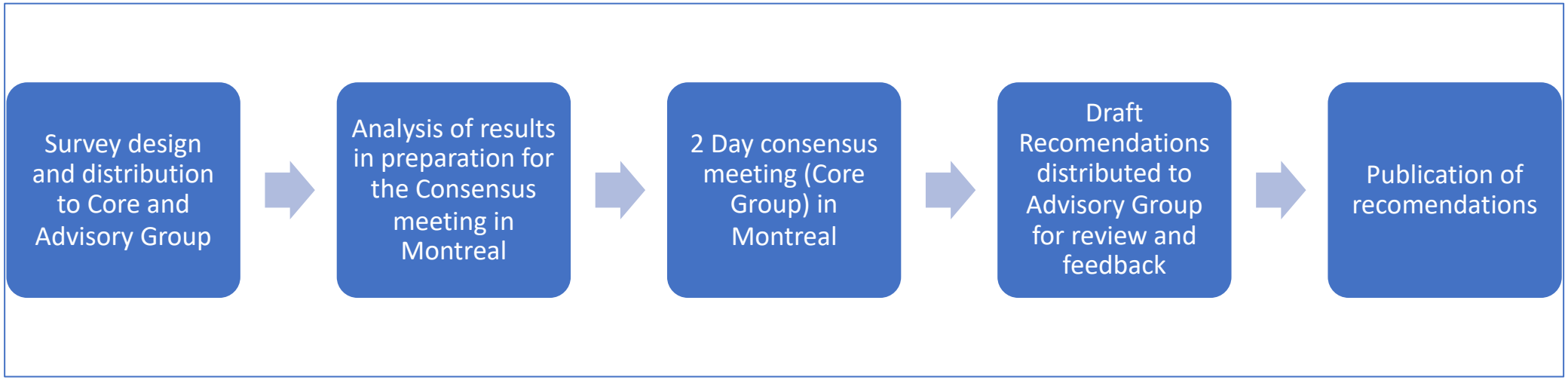
Goals

1. Identify critical **knowledge gaps**
2. Build **capacity, leadership and networks**
3. Setting new standards through **consensus** building
4. **Identifying target activities to accelerate discovery**

*Impact at 15 February 2019: 20 350 downloads across International Journal of Stroke and Neurorehabilitation and Neural Repair publications.

Reaching a consensus on kinematic measurement tools and protocols

Achieving consensus between 13 experts (Core N=5 Advisory N=8)



- Survey comprising 13 Yes/No, multiple-choice and open questions on:
  - Types of movement and specific tasks that should be assessed
  - Tools (e.g. motion capture) including psychometric properties; data sampling and feasibility
  - Analysis - metrics
  - Protocols and timing of assessment
- Results analysed prior to the consensus meeting

Two types of performance assays

1. 2D performance assays that isolate movements outside a motor task context (i.e. that quantify restitution)
2. A standardized functional task
   - applicable to the dominant and non-dominant arm
   - can be accomplished through behavioural restitution and/or compensation
   - but using 3D kinematic analysis to separate the contribution of each component

Recommended 2D-performance assays

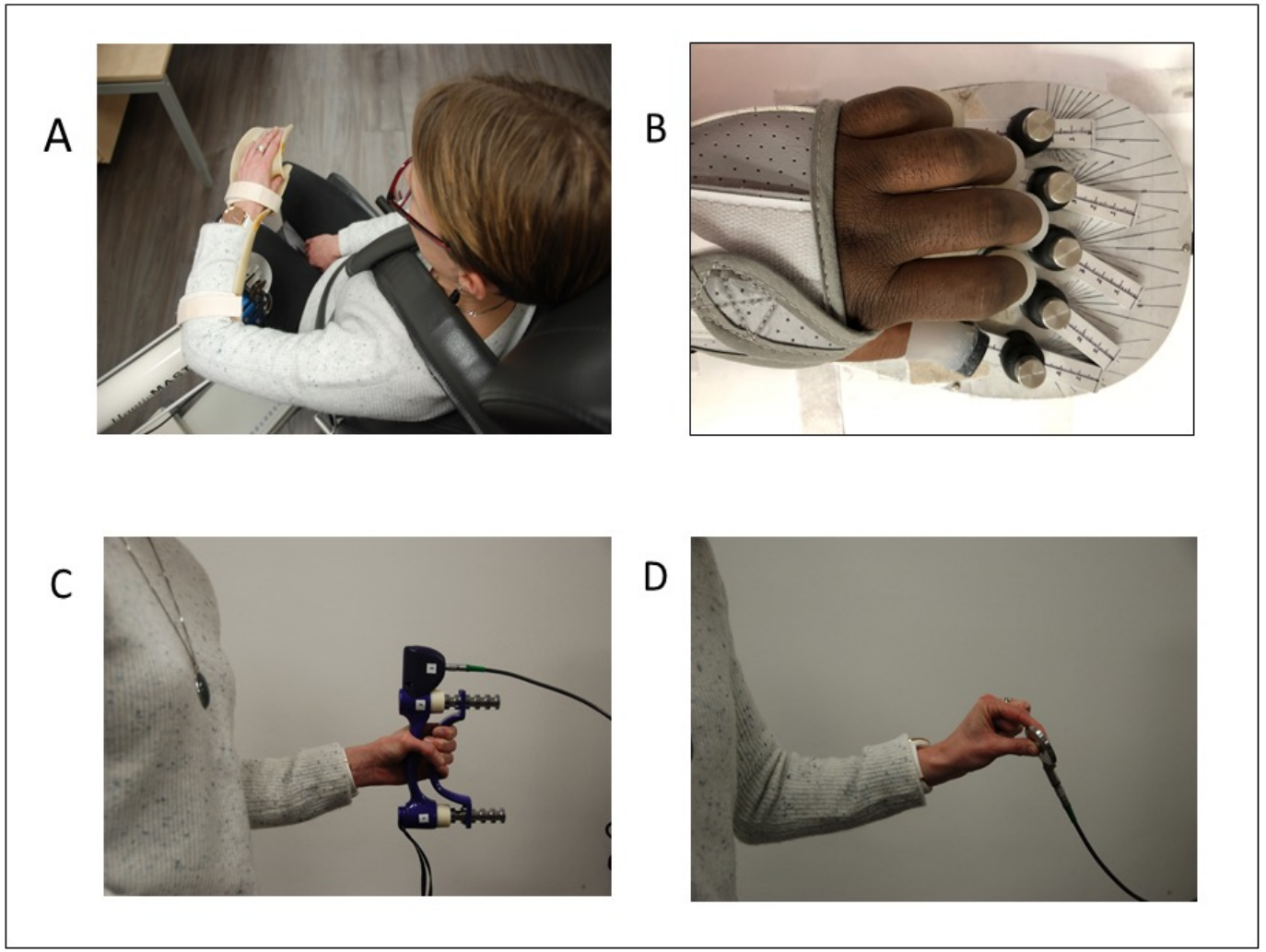
A. 2D-planar reaching task performed in a Haptic Robot

B. Finger individuation device

C. Testing grip strength[1]

D. Testing precision grip[1]

[1]*Electronic Pinch Dynamometer, Biometrics Ltd., UK*



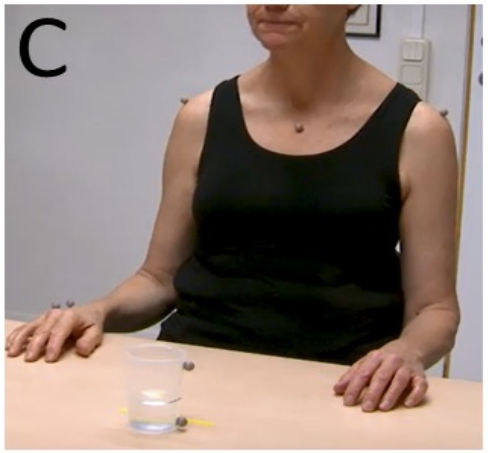
Recommended 3D-functional task

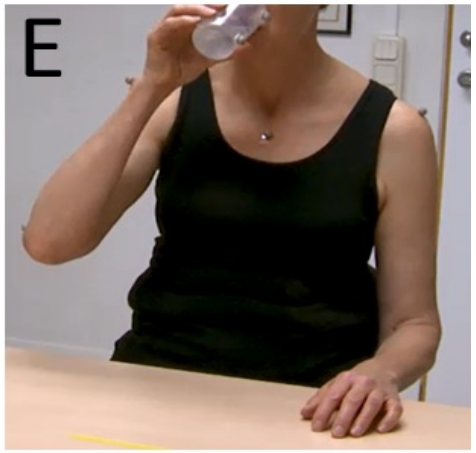
A & B Sitting position

C: start / end position

D: end of reach phase (grasping cup)

E: drinking phase





- Lower function may omit grasping

Key findings and recommendations

- Neural restitution relates closely to fine-grained movement quality measures that are sensitive and specific
- Distinguish recovery from compensation
- Protocols (application and analysis) and tools should be conceptually rigorous, reliable, valid and responsive to change
- Currently only high-resolution digital optoelectronic systems should be used

Kwakkel, Burridge et al. Standardized measurement of quality of upper limb movement after stroke: Consensus-based core recommendations SRRR2. International J of Stroke. Accepted June 2019

Prange-Lasonder *et al.*
J NeuroEngineering Rehabil (2021) 18:162
https://doi.org/10.1186/s12984-021-00951-y

Journal of NeuroEngineering and Rehabilitation

RESEARCH **Open Access**

European evidence-based recommendations for clinical assessment of upper limb in neurorehabilitation (CAULIN): data synthesis from systematic reviews, clinical practice guidelines and expert consensus

Gerdienke B. Prange-Lasonder[1,2*], Margit Alt Murphy[3], Ilse Lamers[4,5], Ann-Marie Hughes[6], Jaap H. Buurke[1,7], Peter Feys[4], Thierry Keller[8], Verena Klamroth-Marganska[9], Ina M. Tarkka[10], Annick Timmermans[4] and Jane H. Burridge[6]

Synthesized recommendations for assessments from:

1. Systematic review of Current National and International Guidelines[1]
2. Delphi consensus[2]
3. An Overview of Systematic reviews of Upper extremity Outcome measures after stroke[3]

1. J. Burridge et al. Frontiers in Neurology 2019 Vol. 10 DOI: 10.3389/fneur.2019.00567
2. AM Hughes et al. Journal of NeuroEngineering and Rehabilitation (2016) 13:86 DOI 10.1186/s12984-016-0192-z
3. M Alt Murphy et al. BMC Neurology (2015) 15:29 DOI 10.1186/s12883-015-0292-6

CAULIN Recommendations: Agreed Purpose of Assessment

- Identify and prioritise problems
- Support clinical and management decision making
- Measure progress
- Predict outcome
- Facilitate communication between members of the MDT;

What Current National and International Clinical Guidelines say about upper limb assessment in neurological rehabilitation

- Systematic review of published guidance (measures and protocols)
  - Of 552 records 35 satisfied inclusion criteria (made reference to assessment of UL)
  - Divided into National Guidelines and other published practice guidelines
- Agreement that assessment is critical
  - Conducted early and at regular intervals
  - By a healthcare professional trained in using the measure
  - Encompassing body function and structure, activity and participation
- Only 6 guidelines recommended specific outcome measures and /or protocols
- Conclusions:
  - Current lack of guidance may hold-back progress in understanding function and recovery
  - Need for consensus
  - Need for International Guidelines on assessment

Burridge et al. A review of international clinical guidelines for rehabilitation of people with neurological conditions: what recommendations are made for upper limb assessment? Frontiers in Neuroscience 2019

Measurement tools and protocols

- Tools
  - Valid and reliable
  - Responsive in the stroke population
  - Meet the needs of the patient
- Protocols
  - Administered by trained professionals
  - Early after onset, prior decision making (discharge, transfer)
  - Before, during and after treatment
  - Assessment of < 15 minutes is most acceptable for the patient and assessor.
  - Assessment of < 30 min acceptable
  - No test battery should be longer than 3 hours

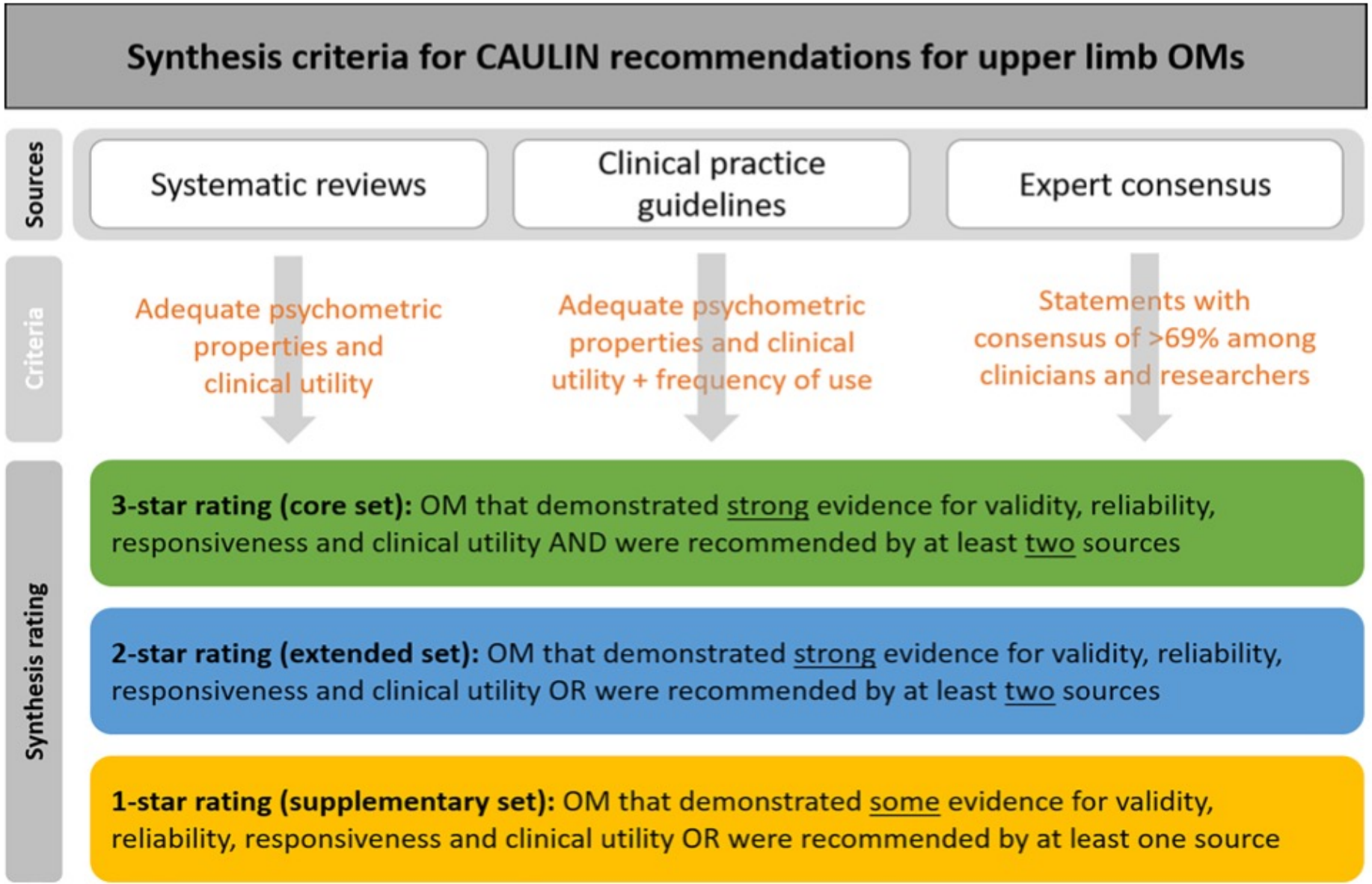


Fig. 1 Schematic view of synthesis criteria for compiling CAULIN recommendations

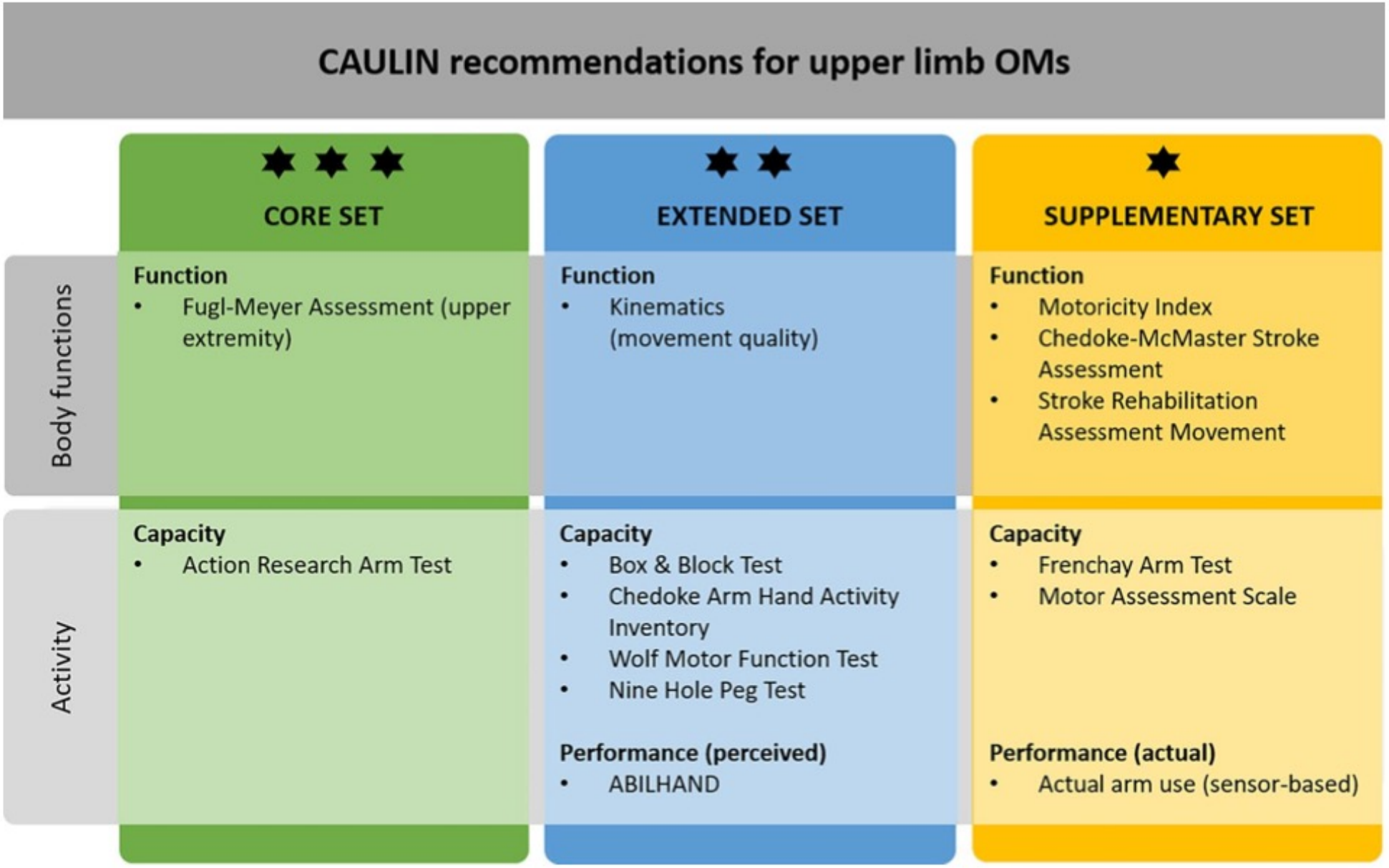


Fig. 2 CAULIN recommendations for selected specific upper limb outcome measures in neurorehabilitation

Wearable sensors..

- Are widely used outside healthcare
- Monitor quality and amount of movement and provide feedback
  - Clinical decision-making – choice of treatment
  - Detect changes in response to treatment
  - As feedback to motivate, guide and encourage – real time and summary and sometimes interacting with computer games
- Platform for remote monitoring

In Summary

- Strong agreement between SRRR2 and CAULIN
- Distinguishing recovery from compensation is essential for understanding mechanisms of recovery and deterioration
- And therefore to advance and optimise treatment
- Use the same core measures so that data can be pooled, trials and interventions compared
- The SRRR2 reached consensus on tools and protocols for measuring quality of movement (recovery)
- Cost Action reached consensus on Clinical Assessment of the Upper Limb In Neurorehabilitation (CAULIN)

Adine Adonis

Chair of ACPIN (Association of Chartered Physiotherapists in Neurology)

Evidence and how to use it

Can stroke rehabilitation benefit from advances in understanding neuroplasticity and motor learning?

- Neuroplasticity is fundamental to recovery (and learning)
- Changes in structure and function of the CNS
- Prevention of spasticity by supporting movement
- Models of practice
- Remember that repetition is not enough….

How therapy can promote recovery

- Intensity
- Facilitating normal movement patterns
- Preventing unwanted movement patterns
- Motivation – feedback
- Interacting with patient’s goals and needs

Is rehabilitation technology useful?

- It should be if:
  - Amount and intensity of practice is important in recovery
  - Technology can provide greater amounts and intensity
- But is there strong evidence for either?
- If we understood how and when technologies should be used…
- Movement data are critical

Systematic Review of the Evidence

- “Time spent in rehabilitation: effect on measures of activity after stroke”
- Published in 2021
- International team of authors

Clarke, B., Burridge, JH. et al, “The effect of time spent in rehabilitation on activity limitation and impairment after stroke." Cochrane Database of Systematic Reviews(10).

Review Methodology

People who have had a stroke, 18+, including SAH

Rehabilitation

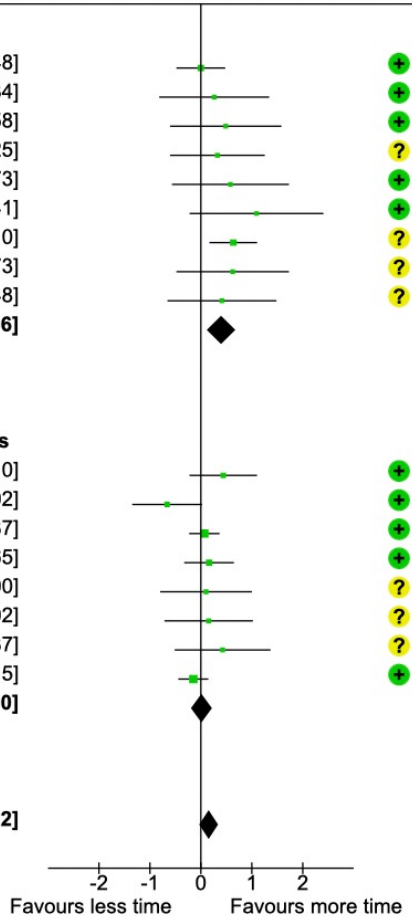
Different amounts of time spent in the **same** rehabilitation intervention

ADL, UL & LL Activity, UL & LL impairment, participant experience

Review findings – searches:

- Identified 36,880 unique records
- 21 studies met the criteria
- Total of 1,288 participants
- Time since stroke:
  - 16 studies - up to 6 months
  - 5 studies – more than 6 months
- Different types of therapy studies (Physiotherapy/ Occupational therapy, NMES, Robot Assisted Therapy, CIMT, Upper Limb rehab)

Study or Subgroup	More time Mean	More time SD	More time Total	Less time Mean	Less time SD	Less time Total	Weight	Std. Mean Difference IV, Random, 95% CI	Risk of Bias A	B	C	D	E	F
4.1.1 Median split – studies with a larger difference in total amount of therapy between treatment arms														
Ada 2013	22	10	34	22	9	33	9.4%	0.00 [-0.48 , 0.48]	+	+	+	+	+	+
Han 2013a	88	10.33	10	85	11.79	5	2.3%	0.26 [-0.82 , 1.34]	+	+	+	+	?	?
Han 2013b	89.5	6.85	10	85	11.79	5	2.2%	0.49 [-0.60 , 1.58]	+	+	+	+	?	?
Lang 2016c	65.4	22.05	18	58	21.8	6	3.0%	0.32 [-0.60 , 1.25]	?	+	+	-	?	-
Page 2012a	1.62	0.71	8	1.25	0.29	5	2.0%	0.58 [-0.57 , 1.73]	+	+	+	+	?	?
Page 2012b	2.19	0.93	8	1.25	0.29	4	1.6%	1.09 [-0.22 , 2.41]	+	+	+	+	?	?
Wang 2004	88.24	17.95	38	74.42	24.7	36	9.8%	0.64 [0.17 , 1.10]	?	+	+	-	?	-
Winstein 2019a	3.66	0.71	10	3.11	1.05	5	2.2%	0.62 [-0.48 , 1.73]	?	+	+	+	?	?
Winstein 2019b	3.5	0.82	11	3.11	1.05	5	2.3%	0.41 [-0.66 , 1.48]	?	+	+	+	?	?
Subtotal (95% CI)			**147**			**104**	**34.8%**	**0.40 [0.14 , 0.66]**						
Heterogeneity: Tau² = 0.00; Chi² = 5.09, df = 8 (P = 0.75); I² = 0%														
Test for overall effect: Z = 2.99 (P = 0.003)														
4.1.2 Median split – studies with a smaller difference in total amount of therapy between treatment arms														
Burgar 2011	21.5	8.66	17	17.7	8.28	19	5.5%	0.44 [-0.22 , 1.10]	+	-	+	+	?	-
Dromerick 2009	26.93	4.84	16	30.21	4.84	19	5.2%	-0.66 [-1.35 , 0.02]	+	+	+	+	-	-
English 2015	96.2	20.3	88	94.8	20.4	85	17.7%	0.07 [-0.23 , 0.37]	+	+	+	+	+	+
GAPS 2004	16.6	2.8	32	16.1	3.3	33	9.2%	0.16 [-0.33 , 0.65]	+	+	+	+	?	?
Kowalczewski 2007	0.04	0.054	10	0.035	0.038	9	3.2%	0.10 [-0.80 , 1.00]	?	+	+	+	?	?
Lang 2016a	61.5	22.24	19	58	21.8	7	3.4%	0.15 [-0.71 , 1.02]	?	+	+	-	?	-
Lang 2016b	67.8	22.25	17	58	21.8	6	3.0%	0.43 [-0.51 , 1.37]	?	+	+	-	?	-
Lincoln 1999	12	5.93	87	13	7.41	90	17.9%	-0.15 [-0.44 , 0.15]	+	-	+	+	?	-
Subtotal (95% CI)			**286**			**268**	**65.2%**	**0.01 [-0.18 , 0.20]**						
Heterogeneity: Tau² = 0.01; Chi² = 7.82, df = 7 (P = 0.35); I² = 10%														
Test for overall effect: Z = 0.11 (P = 0.91)														
Total (95% CI)			**433**			**372**	**100.0%**	**0.15 [-0.02 , 0.32]**						
Heterogeneity: Tau² = 0.02; Chi² = 19.04, df = 16 (P = 0.27); I² = 16%														
Test for overall effect: Z = 1.78 (P = 0.08)														
Test for subgroup differences: Chi² = 5.53, df = 1 (P = 0.02), I² = 81.9%														



Risk of bias legend

(A) Bias arising from the randomization process
(B) Bias due to deviations from intended interventions
(C) Bias due to missing outcome data
(D) Bias in measurement of the outcome
(E) Bias in selection of the reported result
(F) Overall bias

Comparison 4: Objective two: effect of total time spent in rehabilitation, Outcome 1: Activities of daily living outcomes: immediately after intervention

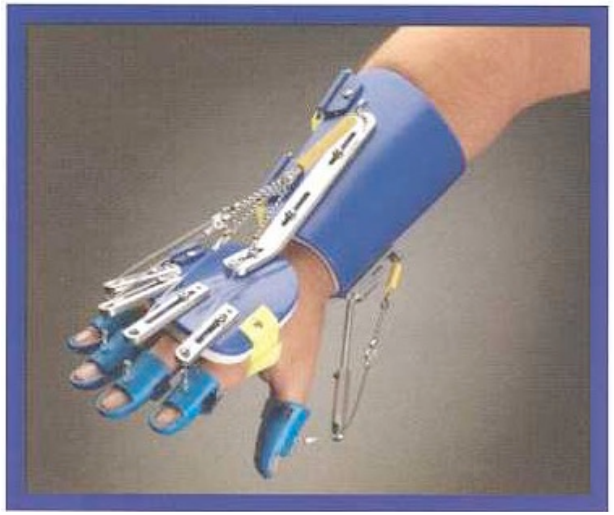
Conclusion

- Small amounts of additional rehabilitation are unlikely to improve clinical outcomes
- Large amounts of additional rehabilitation may be beneficial
- Implications:
  - Prioritise patients
  - Technologies to increase amount of therapy
  - High quality trials - differences in amount of intervention
  - Standardised outcome measures to enable pooling of data

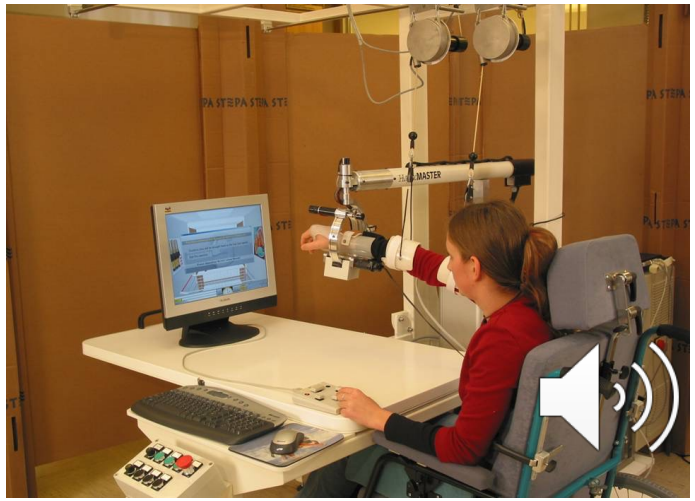
Evidence for effectiveness of a few technologies

Saeboflex

- Enables practice of functional tasks
- With more normal movement patterns
- Especially in people who have active grip but problems opening the hand
- Very little research evidence
- Popular with physiotherapists



Robot therapy



Theoretical benefit of Rehabilitation Robots

- Robot will allow the patient to achieve a task
  - Repetitions
  - Graded (support or resistance – intelligent adjustment)
  - Motivating
  - Intensive and safe training
- Appropriate for all levels of ability

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UCLH robots help stroke patients regain upper limb movement

13 November 2017 - 11:22am

Staff at UCLH's stroke rehabilitation unit, including physio assistants, have become the first in the NHS to use robotic devices in conjunction with more traditional therapies to help patients regain arm and hand movement.

An occupational therapist supervises a patient as they use the robotic device. Photo ©UCLH

The robots, which help patients practise exercises to build up strength and dexterity, can be supervised by a physiotherapy assistant and were introduced as part of UCLH's intensive three-week upper limb neuro rehabilitation programme.

ADDED BY:
Frontline

TAGGED AS

Robotics, stroke rehab

MORE FROM THE CSP

Evidence for Robot Therapy

- Evidence for improved motor control (impairment) and some evidence for improved function [Kwakkel 2008, Mehrholz 2010, EBRSR & Prange 2006]. People with moderate impairment may respond better
- Proximal training = proximal benefit
- Better understanding of how therapy should be applied
- Need for standards in protocols and outcome measures

The drug trial model will not work

- Rehabilitation is not a pill
- Impossible to get sufficient ‘N’ of participants who will respond well
- So the temptation has been to recruit large numbers of unsuitable participants and give them all the same treatment
- For example the RATULS trial

Robot Assisted Training for the Upper Limb after Stroke (RATULS): a multi-centre randomised controlled trial comparing robot-assisted training; an enhanced upper limb therapy programme; and usual care.

Trial design

Screening/baseline assessment/randomisation
770 adults 1 week to 5 years post stroke with moderate to severe arm functional limitation.

Robot assisted training (RT) (n=257)

Provided for 45 min, 3 days per week for 12 weeks

Enhanced upper limb therapy (EULT) (n=259)

Provided for 45 min, 3 days per week for 12 weeks

Usual care (UC) (n=254)

Participants received usual post stroke care

Three month outcome assessment

1. Upper limb function (Action Research Arm Test)
2. Upper limb impairment (Fugl-Meyer Test)
3. Activities of daily living (Barthel ADL Index)
4. Quality of life (Stroke Impact Scale, EQ-5D-5L)
5. Adverse events including upper limb pain

Six month assessment
Outcome measures as above plus resource usage

RATULS

Newcastle University
Institute of Neuroscience

Conclusions

Upper limb impairment: Fugl-Meyer motor score

- RT and EULT led to improvement in upper limb impairment compared to UC

Primary outcome: ARAT success at 3 months

- RT using the MIT-Manus robotic gym (shoulder-elbow, wrist and hand modules) did not improve upper limb function when compared to EULT or UC
- EULT did not improve upper limb function when compared to UC

Activities of daily living: Stroke Impact Scale

- EULT led to improvements in ADL compared to RT or UC

Funded by the NIHR Health Technology Assessment programme (project number 11/26/05). The views and opinions expressed here are those of the authors and do not necessarily reflect those of the HTA programme, NIHR, NHS or Department of Health.

RATULS – why were results neutral?

- N=770 – selection criteria
- Dose: 45 minutes 3xweek 12 weeks
- Heterogeneous sample all had the same intervention
- Was there contamination?
- Comparisons between Robot vs. EULT vs. usual care

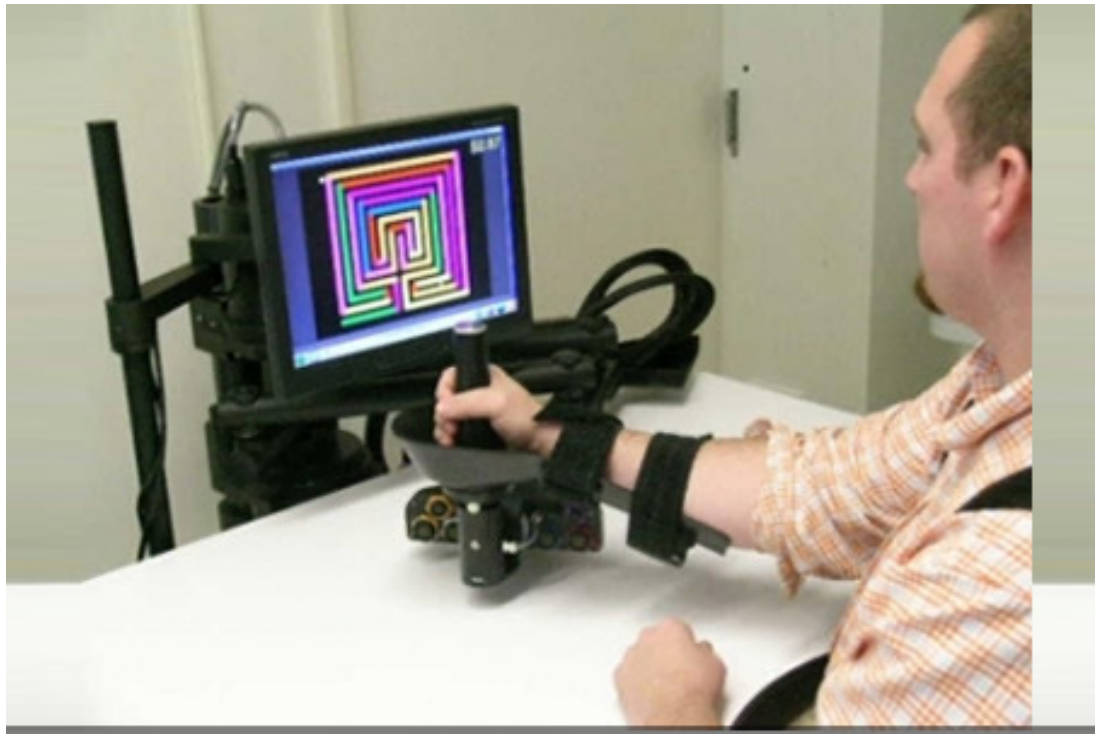
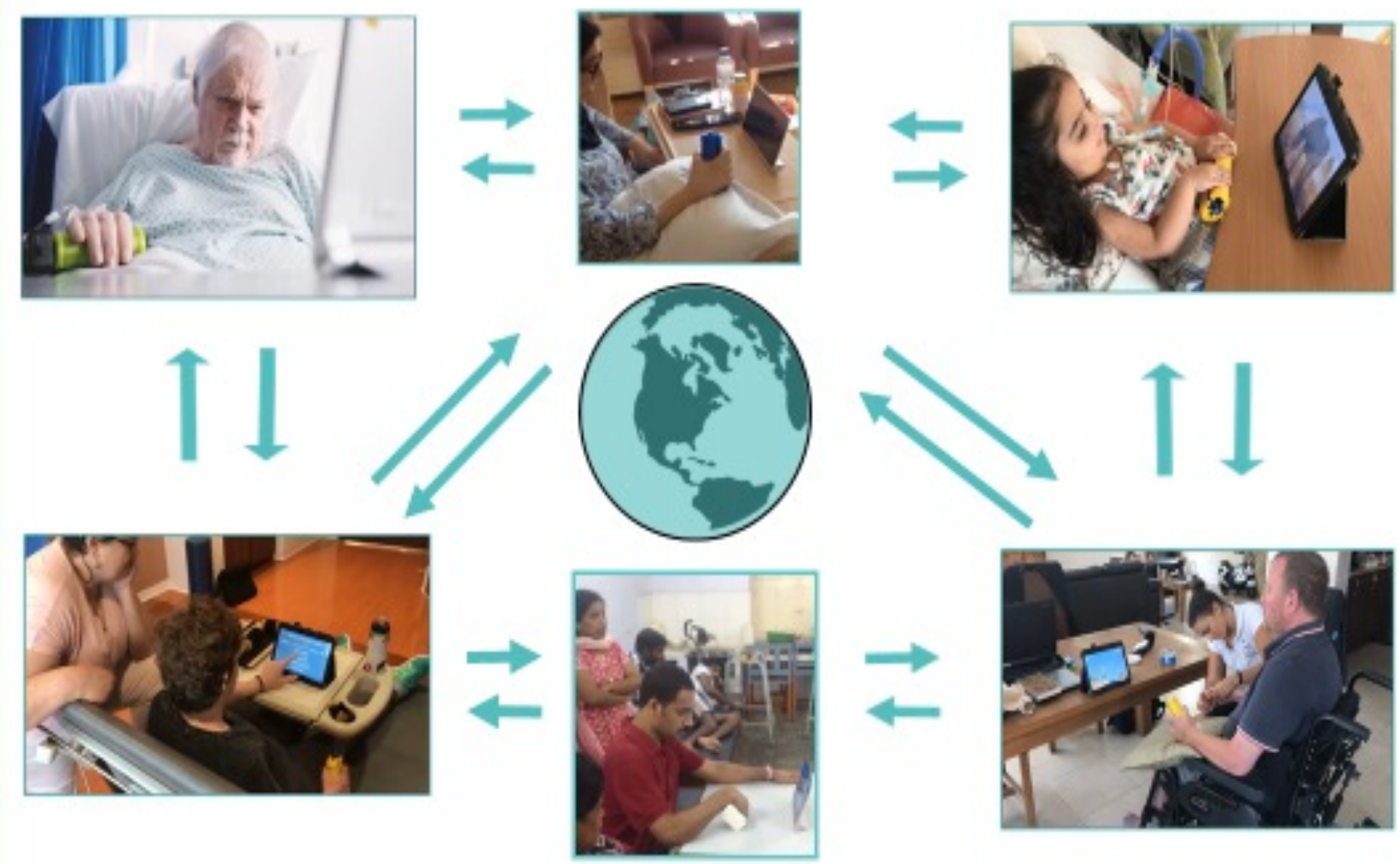


Image Credit: Department of Veterans Affairs

GripAble

- Affordable (<£500)
- Accessible
- Adaptable
- Motivational
- Quick to set-up
- Interactive
- Assessment & goal-setting



GripAble

zoom_0.mp4


Serious. Fun. Rehab.
QUICK SET UP GUIDE
FROM HOSPITAL TO HOME
GRIPABLE
SERIOUS. FUN. REHAB.

Feasibility Results

Hypothesis:	Results
Stroke patients with UL weakness will engage in increased independent exercise (without direct professional supervision), when provided with an adapted gaming device	**GripAble use N=20:** Data from GripAble device (n=10): 31 minutes daily (0.04-126 minutes) Self-reported (n=20): 26 minutes daily (15-45 minutes) Repetitions: 360 task specific UL repetitions per day (2.3- 1243)

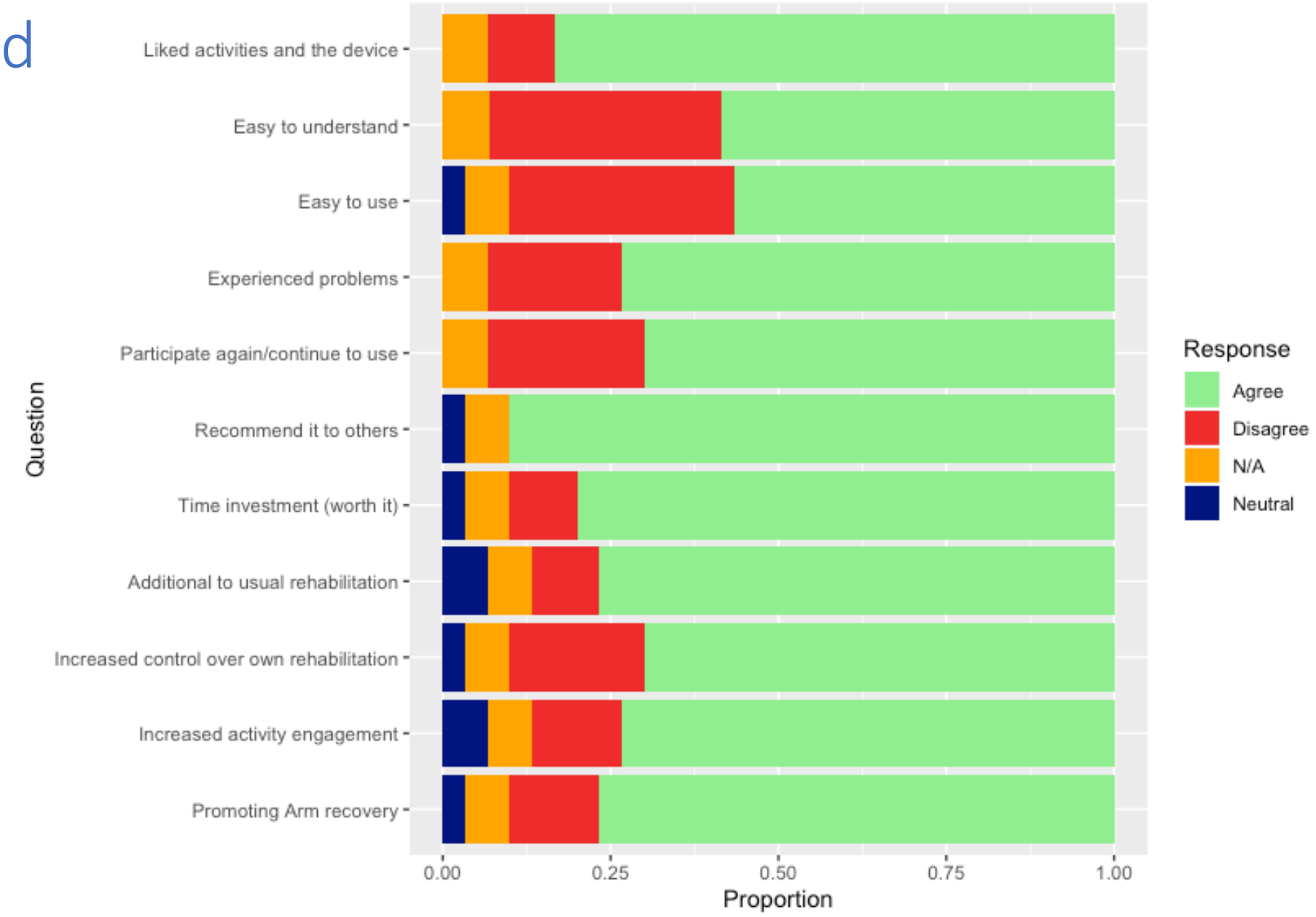
Broderick, M., et al. (2021). "Self-Directed Exergaming for Stroke Upper Limb Impairment Increases Exercise Dose Compared to Standard Care." Neurorehabil Neural Repair: 15459683211041313.

Questionnaire and interview data

"It inspired me to do something. Some (activities) harder than others- I found ones that worked for me"

" found it very useful….definitely helped with boredom.
It will help me improve and regain my confidence"

"I find it a very nice game, good and very interesting.
Sometimes I go to touch it and it doesn't work, sometimes I want to play but it doesn't work."



Conclusion

- Self-directed UL therapy with GripAble is safe and can provide a high dose of rehabilitative therapy
- Acceptability and use was linked to NIHSS (level of disability) score
- Pilot randomised control trial
- Definitive clinical trial

Summary

- Clinical decision-making can be informed by an understanding of:
  - Neuroscience – physiology and behavioural
  - Recovery profiles
  - Motor learning principles – especially implicit vs. explicit learning and Internal vs. external focused tasks
- Assessment and the use of agreed measures is critical to effective therapy and advancing neurological rehabilitation
- Amount of therapy matters
- Technologies may be useful but we need better evidence
- Affordable easy-to-use technologies may be the most effective and complement current practice

Take Home Message

As a therapist you ask:

'What does my patient want to achieve?'

But ~~should~~ will you also ask:

'What neurological impairment am I treating?'

'What neurological change am I expecting?'