Constraint Induced Movement Therapy

MUSC Health
Medical University of South Carolina

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Course Topics:

1) Brief overview and background; current definitions of CIMT
2) CIMT and Bimanual – which to select?
3) CIMT nitty gritty – the MR3 Cycle
4) Toy Essentials
5) CIMT – Fidelity of treatment
6) Current research
7) Assessment – ABILHAND Kids
8) Infant/Baby CIMT
9) MUSC CIMT Program

What is Constraint Induced Movement Therapy (CIMT)?

A systematic, multi-component, intensive therapy designed for individuals with hemiparesis

Primary distinguishing features include:

1. Constraint of less involved upper extremity
2. High intensity of shaping & repetitive practice

Guided by prior research with adult patients after Stroke

Tested via multiple clinical studies and RCTs

Varied treatment protocols

Constraint-Induced Movement Therapy: (CIMT)

- Definitions
  - **Signature CIMT** - The non-affected upper extremity (UE)is completely restrained for an extended time period (6 hours a day to 90% of waking day). Concentrated, repetitive training of the affected limb is provided by a skilled therapist.
  - **mCIMT** – modified to fit the unique needs of children using age appropriate activities that are meaningful to the child. Restraint of the non-affected UE is applied with concentrated, repetitive training of the affected limb is provided by a skilled therapist.
    - research supports various models
  - **Hybrid CIMT** - key ingredients are included and bimanual training is added to different extents. This model significantly alters the unimanual construct of the method.
  - **Forced Use** – restraint of the non-affected UE is applied but no additional training is provided to the affected limb.

Early History of Pediatric CIMT

Adapted by therapists and scientists(3 separate teams) in late 1990s

Initial case histories confirmed with RCT:

- Feasibility of high intensity therapy for infants, toddlers, and **preschooler**, and **school-age children;**
- Constraint was safe, acceptable;
- Objective and subjective measures showed clinically meaningful gains (pre to post-treatment); &
- Gains maintained.

Multiple Systematic Reviews

Ramey, S.L. & DeLuca, S.C. (2013). Pediatric constraint-induced movement therapy: History and definition. In S.L. Ramey, P. Coker-Bolt, & S.C. DeLuca (Eds.), *Handbook of pediatric constraint-induced movement therapy (CIMT): A guide for occupational therapy and health care clinicians, researchers, and educators.* (pp. 19-39). Bethesda, MD: AOTA.

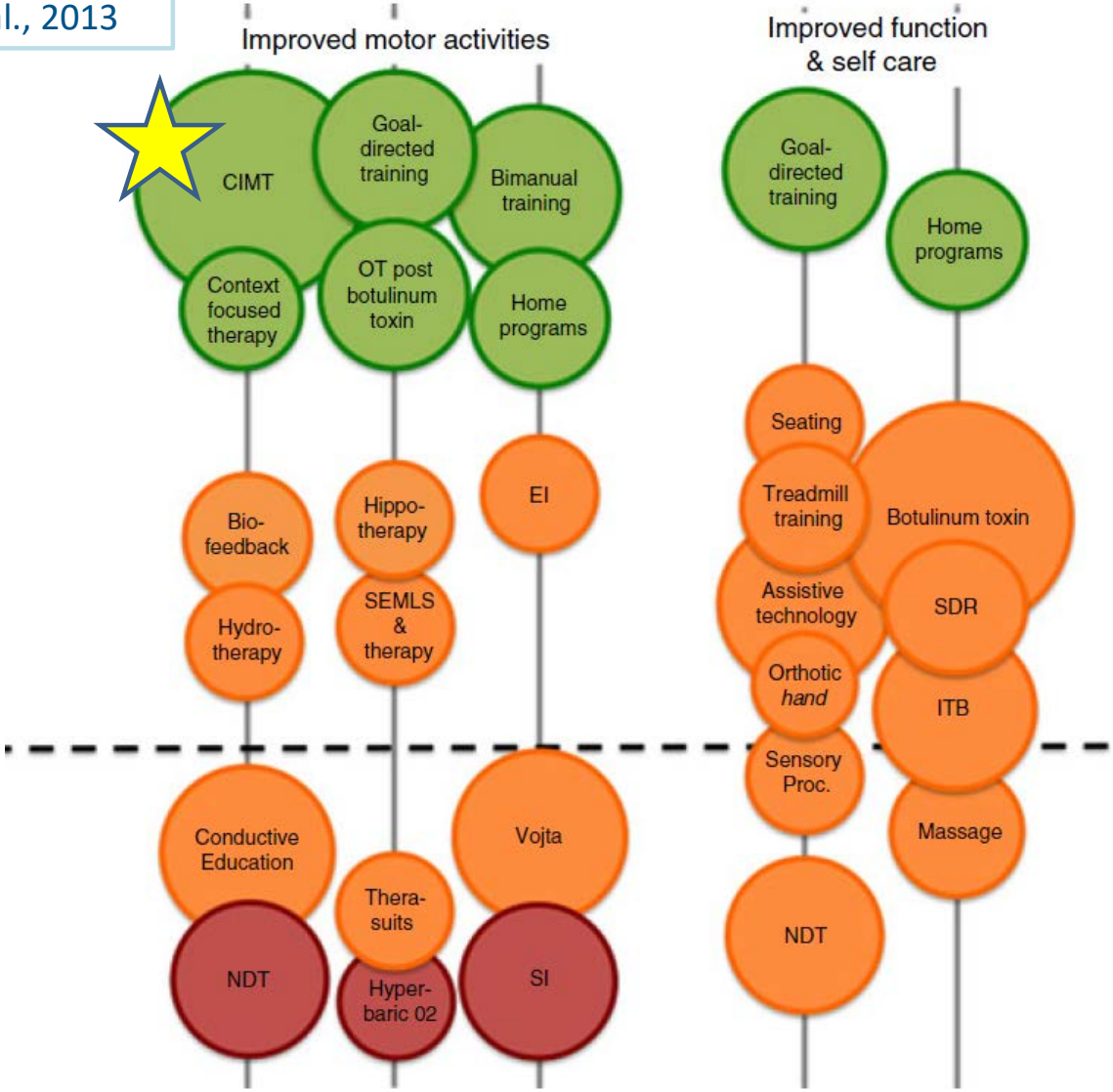
Reiss, A.P., Wolf, S.L., Hammel, E.A., Erin L. McLeod, E.L., & Williams, E.A. (2012). Constraint-Induced Movement Therapy (CIMT): Current perspectives and future directions. *Stroke Research and Treatment*, *Article ID 159391*, 1-8. doi:10.1155/2012/159391

Review of 166 articles using 64 discrete interventions for children with CP

(Novak et al, 2013)

- Only 16 of the 64 judged to be worthy of recommending
- Included in this short list are two fairly recently developed "high-intensity therapies"
  - **Constraint-induced movement therapy (CIMT)**
  - **Bimanual training**
- CIMT produced largest benefits of all interventions and had rigorous scientific evidence

Novak, et al., 2013



CIMT Theories Support Efficacy

Learned Non-Use

- Indicates that there are more neural substrates available during a chronic period after an injury than during the acute period, and these substrates are often underutilized

Cortical reorganization which is theorized to be “use dependent”

- The more something is used the larger the cortical representation

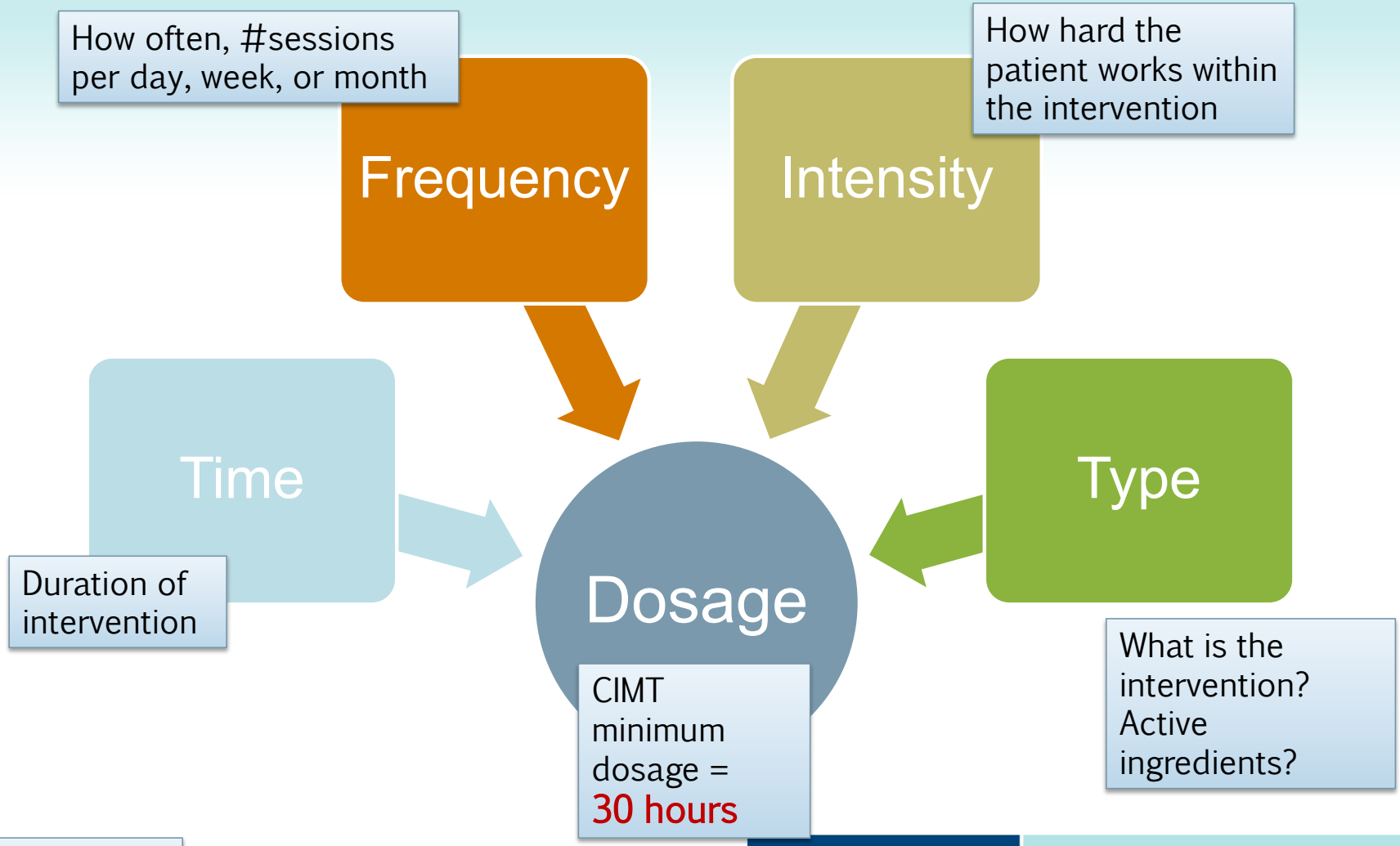
5 Essential Elements of P-CIMT

Elements
Constraint of the less impaired upper extremity
High dosage (beyond typical therapy schedules)
Use of **shaping techniques and repetitive practice** with task variation
Learning functional skills in the child's **natural environment**
A **transition/discharge program** is provided.

Ramey, Coker-Bolt, & DeLuca, 2013

Intensive Therapies & Dosage

What Does it All Mean?



(Kolobe, T. et al., 2014)

CIMT

CIMT and Bimanual

CIMT

- High Intensity
- Behavioral Training
- Goal Directed
- Constraint of a Weaker Arm and Hand
- Uni-manual

Bimanual

- High Intensity
- Behavioral Training
- Goal Directed
- Bimanual

Unimanual

Bimanual

Videos

Which to Use P-CIMT or Bilateral?

Have you tried P-CIMT or Bilateral Intensive Treatments before?

In general, a child must develop a recognition of the weaker arm and hand to be able to use it for unilateral of bilateral activities

P-CIMT might be a first choice if intensive therapies have not been done

Age of the Child?

6-12 months
12-36 months
36 months – 5 years
6 years – 12 years

Child's ability and level of function (MACS Level)

- Does the child have some functional use of the weaker Arm & Hand, what is the child's level of function?

  Can you make the treatment process feel successful?

CIMT

Breaking down the CIMT cycle

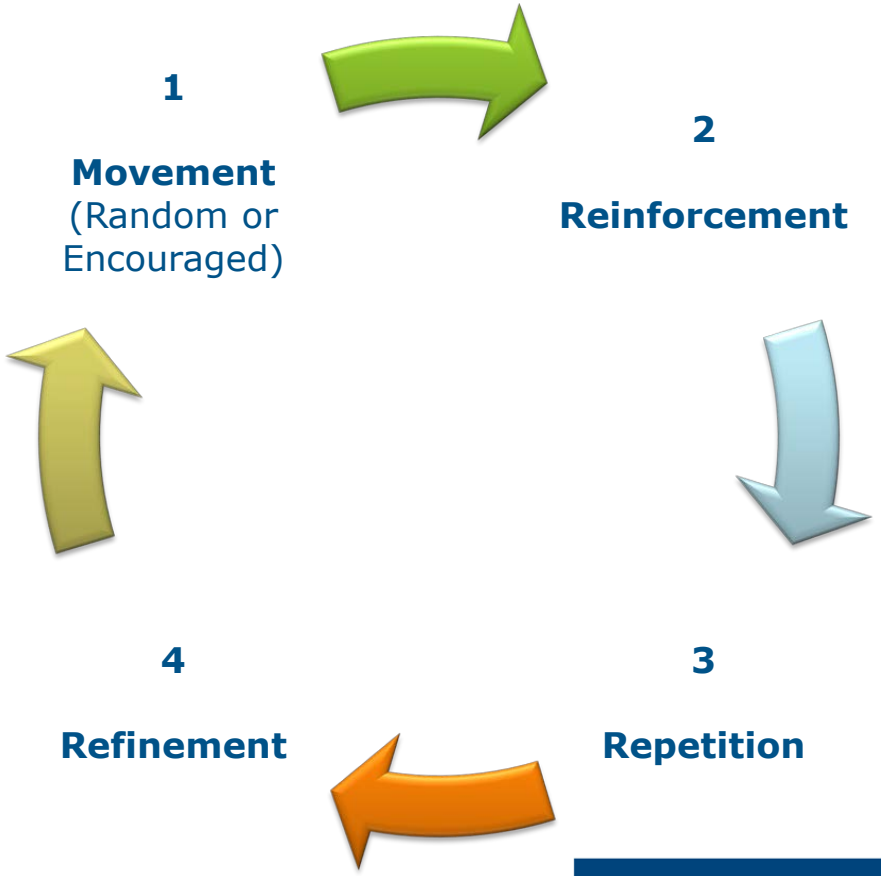
“MR3 cycle”

Therapy Cycle During Treatment

MR3 Cycle

- Movement-Reinforcement-Repetition-Refinement
  - **Movement** is encouraged, prompted, and stimulated, and the movement of the upper extremity starts the cycle
  - **Reinforcement** is immediate, positive, and motivating for the child
  - **Repetition** occurs immediately and over extended period of time after other activity cycles
  - **Refinement** occurs at natural times as skill progresses

Intensive Treatment Burst using Operant Conditioning: "MR3 Cycle"



What movement is needed to help child accomplish the goal?

Movement from:

- Shoulder
- Elbow
- Forearm
- Wrist
- Fingers/thumb

Accurate reach, grasp, release

Strength/power

Videos

What types of toys can be used to help you move through the MR3 cycle?

Consider the properties of toys which can facilitate or enhance movement experiences.

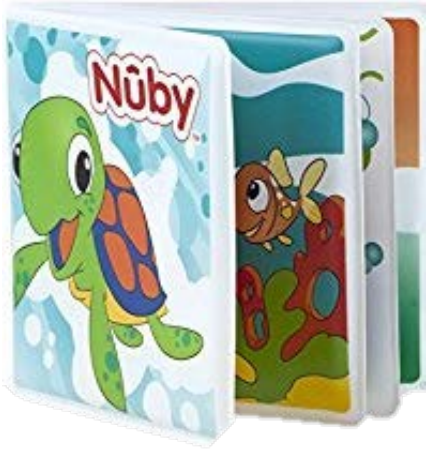
Toy Essentials Handout

Categories of Toys

Toys that are easy to hold
(large versus smaller handles)

Large Toys (books, large ball)

Toys that can be pulled apart
and pushed together



Categories of Toys

Toys with parts inserted/inside the main toy

Toys with surfaces to explore or that produce sounds

A pair of toys that are meant to be played with together

CIMT

Assuring CIMT program is a CIMT program….

Treatment Fidelity is…

The degree to which the treatment actually delivered to a patient **matches the treatment specifications**.

This necessitates a well-specified (ideally written or manualized) treatment protocol.

- *Our field of pediatric medical rehabilitation has lagged in this area….*

Treatment fidelity helps in "unpacking the black box" of treatments - because it provides systematic information about whether the content and approach are **"true to the model"** (intended treatment).

- *It facilitates replicability and maintenance of high standards*.

Common Core Elements of P-CIMT

(cf. Ramey, Coker-Bolt, & DeLuca)

Structural Core Elements

- **Constraint of less impaired Upper Extremity (type, amount)**
- **High Intensity (requires specification)**
- Treatment Plan with specified goals
- Transition Plan building on progress
- Trained provider/parent
- Natural environment

Functional Core Elements

- **Active Shaping & Successive Approximations (reach higher goals)**
- **Repetitive practice with feedback**

Good Pediatric Practice Principles

Measuring how you complete P-CIMT Fidelity Measure

Pediatric Constraint-Induced Movement Therapy (P-CIMT) COMPONENTS

Does the constraint of less impaired or unimpaired upper extremity meet the standards for the type and amount specified by the protocol.	Yes	No
High intensity of intervention (at least 1.5 hours per session, at least 3 days per week for at least 2 weeks)	Number hrs/day _____ Number days/wk _____ Number weeks _____	
Intervention is provided by a trained therapist after receiving specialized training and guidance	Yes	No
Intervention is based on principles of active shaping and repetitive practice with appropriate feedback		
Parent education and support related to the child's course of P-CIMT		
Post-therapy transition plan or package that builds on the child's progress		
Describe environment therapy delivered in (e.g. clinic, home, playground)		

1. Choice of Tasks and Activities (Part of Eliciting Movement "M")	Rating is _____
Therapist selects activities appropriate for shaping Therapist selects activities and tasks that can challenge the child to perform at appropriate higher levels	
2. Interaction and Engagement (Part of Eliciting Movement "M")	**Rating is _____**
Therapist demonstrates positive affect to the child. Therapist elicits high child engagement throughout the session Therapist and child collaborate in selection and progression of activities.	
3. Guidance Modeling, Prompting to Elicit Movement and Target Behavior (Part of Eliciting Movement "M")	**Rating is _____**
Therapist gives clear information and messages to the child on behavior or actions for the targeted behavior Therapist provides explicit verbal guidance, cueing, modeling and/or prompting to motivate child's action. As the child shows progress, therapist prompts or cues a higher level of performance	
4. Reinforcement (Using Reinforcement Appropriately "R - 1")	**Rating is _____**
Therapist provides reinforcement (e.g., verbal praise, facial or physical gestures) when child demonstrates progress toward targeted behavior. Therapist provides timely (most often immediate) reinforcement of child's efforts. Therapist's reinforcement is appropriate to child's stage of learning. Therapist varies the reinforcement for the child. Therapist provides child with explicit information about performance.	
5. Repetition (Encouraging Movement and Task Repetition "R - 2")	**Rating is _____**
Therapist actively encourages repeated practice of emerging skills. Therapist actively encourages variation in how the child uses new or emerging skills.	
6. Shaping and Adapting Activities (Refining Activities for Successive Approximation to be utilized "R -3"	**Rating is _____**
Therapist appropriately fades or lowers supports to encourage the child's independence in performing the activity. Therapist actively monitors the child during repetitive practice and provides guidance and reinforcement to maintain optimal child effort. Therapist responds to child's level of interest, enjoyment, frustration, or fatigue by modifying activity or communication. If the child struggles with an activity, the therapist adapts it to promote the child's success.	

Interaction Between Therapist and Child Documented via Video-Recording

Score the video-recording on each of the 6 areas labeled below as demonstrating (Listed below each section are examples of things to consider, and a comment space is provided):

3 = Meets High Standards and Expectations for P-CIMT and MR3 Cycle

2 = Has Acceptable Standards and Expectations for P-CIMT and MR3 Cycle

1 = Does Not Meet Standards and Expectations for P-CIMT and MR3 Cycle

CIMT

Fidelity Study in 2 Large Hospitals in Vietnam

10 children

Hanoi Rehabilitation Hospital in Hanoi

10 children

Ho Chi Minh City Children's Hospital #1

AIM

To determine if 2 models of CIMT developed by Vietnamese physicians and therapists **can be implemented with fidelity** within a rehabilitation setting in Vietnam.

Vietnamese CIMT Protocol 1:
4 weeks; 5 days a week; 1.5 hours a day; 30 min. with therapist; 1 hour with parents
**(7.5 hours a week X 6 weeks = 30 hours)

Vietnamese CIMT Protocol 2:
6 weeks: 7 days a week; 1 hour with therapist/1 hour with family for 5 days a week/1 hour each weekend day with family
**(12 hours a week X 6 weeks = 72 hours)

Vietnam CIMT - Video

Assessment

MACS

ABILHAND-Kid and Using and Using Item Map to Guide Decision Making

MACS & Mini-MACS – Manual Ability Classification System

What do you need to know to use MACS?

The child's ability to handle objects in important daily activities, for example during play and leisure, eating and dressing.

In which situation is the child independent and to what extent do they need support and adaptation?

http://www.macs.nu/index.php

I. **Handles objects easily and successfully.** At most, limitations in the ease of performing manual tasks requiring speed and accuracy. However, any limitations in manual abilities do not restrict independence in daily activities.

II. **Handles most objects but with somewhat reduced quality and/or speed of achievement.** Certain activities may be avoided or be achieved with some difficulty; alternative ways of performance might be used but manual abilities do not usually restrict independence in daily activities.

III. **Handles objects with difficulty; needs help to prepare and/or modify activities.** The performance is slow and achieved with limited success regarding quality and quantity. Activities are performed independently if they have been set up or adapted.

IV. **Handles a limited selection of easily managed objects in adapted situations.** Performs parts of activities with effort and with limited success. Requires continuous support and assistance and/or adapted equipment, for even partial achievement of the activity.

V. **Does not handle objects and has severely limited ability to perform even simple actions.** Requires total assistance.

MACS & Mini-MACS – Manual Ability Classification System

Mini-MACS

What do you need to know to use Mini-MACS?

Mini-MACS users need to find out what objects the child usually handles and how they handle them: with ease or difficulty, quickly or slowly, with precision or randomly? For example, you can ask about and/or observe how the child uses his or her hands when playing and during meals, or when participating in usual activities of daily living.

Ask questions about the child's self-initiated ability and how much adult help and support the child needs to handle everyday objects, e.g. toys.

Below is a description of the five Mini-MACS levels of children's self-initiated ability and their need for assistance or adaptation when handling objects.

http://www.macs.nu/index.php

I. **Handles objects easily and successfully**. The child may have a slight limitation in performing actions that require precision and coordination between the hands but they can still perform them. The child may need somewhat more adult assistance when handling objects compared to other children of the same age.

II. **Handles most objects, but with somewhat reduced quality and/or speed of achievement.** Some actions can only be performed and accomplished with some difficulty and after practice. The child may try an alternative approach, such as using only one hand. The child need adult assistance to handle objects more frequently compared to children at the same age.

III. **Handles objects with difficulty.** Performance is slow, with limited variation and quality. Easily managed objects are handled independently for short periods. The child often needs adult help and support to handle objects.

IV. **Handles a limited selection of easily managed objects in simple actions.** The actions are performed slowly, with exertion and/or random precision. The child needs constant adult help and support to handle objects.

V. **Does not handle objects and has severely limited ability to perform even simple actions.** At best, the child can push, touch, press, or hold on to a few items, in constant interaction with an adult.

The **ABILHAND-Kids** is a parent completed questionnaire that assesses manual abilities of children 5 to 15 years of age who have impaired upper limb functions.

Administration

Assessor: The assessment can be administered by an occupational therapist or physiotherapist.

How: The assessment consists of 21 items covering both unimanual and bimanual self-care activities. The parent is asked to estimate the child's ease or difficulty in performing each activity without assistance.

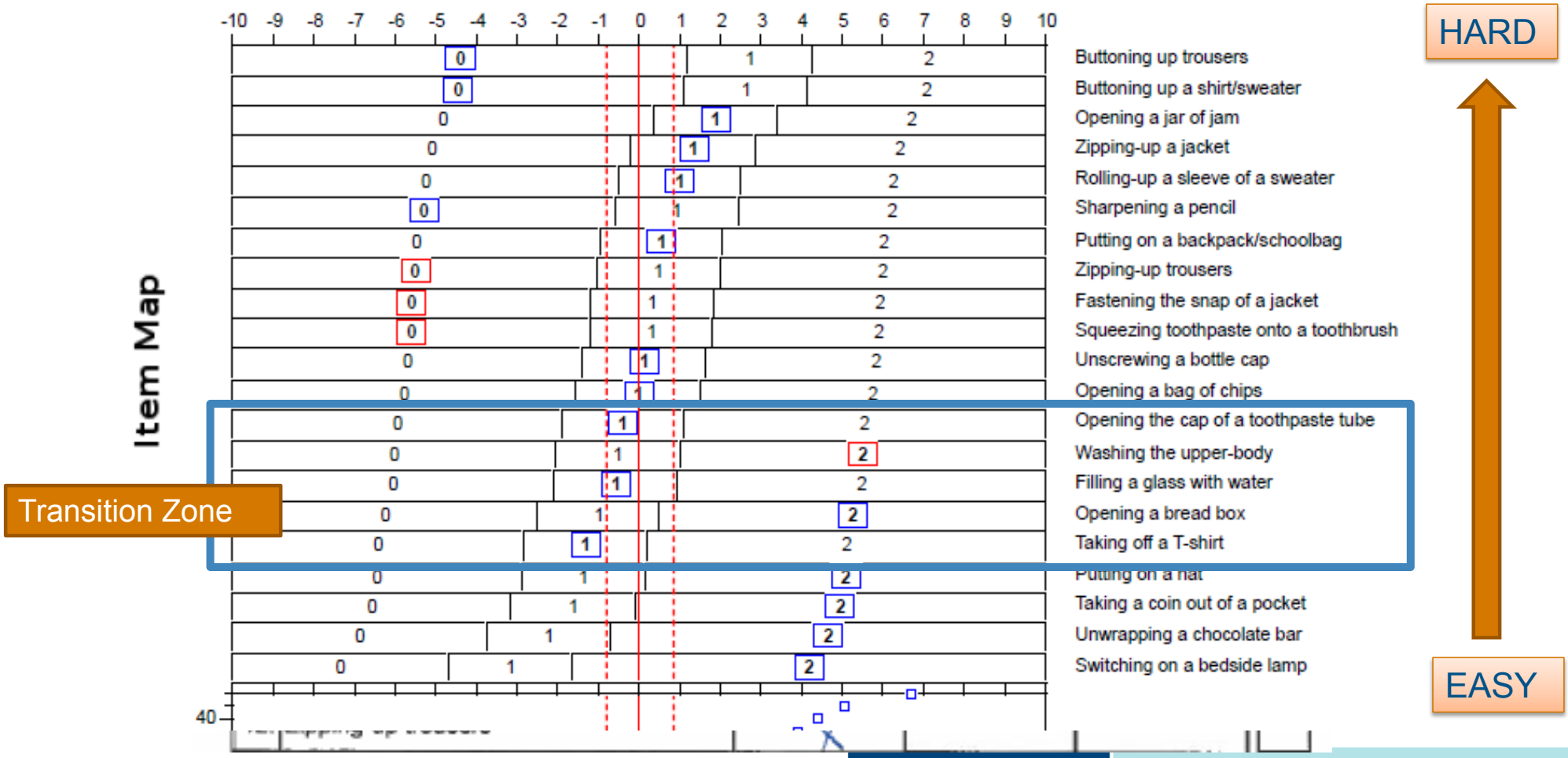
Time: Approximately 20 minutes

Instructions for the ABILHAND-Kids questionnaire

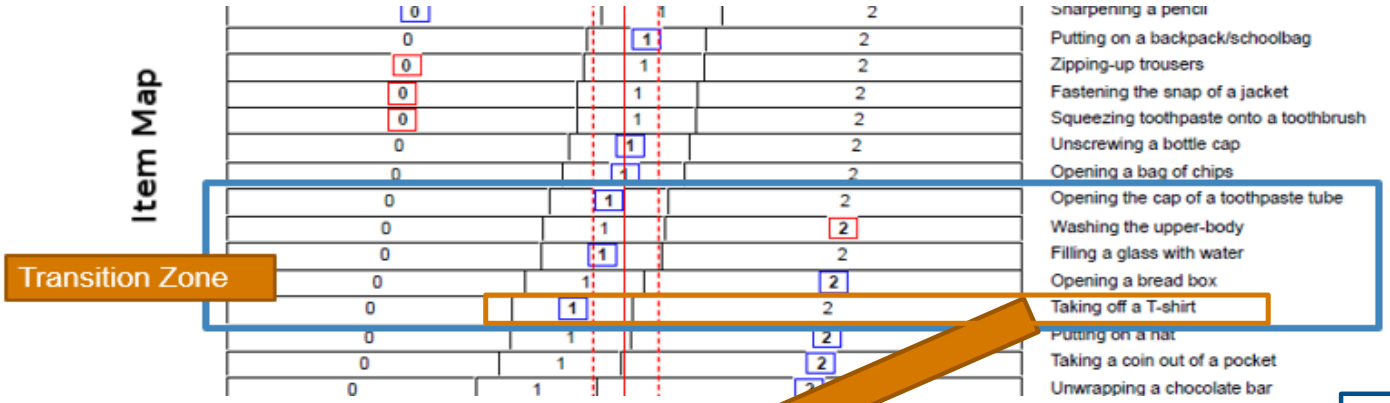
Parents are asked to provide their child's difficulty on a three-level scale: "Impossible", "Difficulty", or "Easy". Activities not attempted in the last 3 months are not scored and are entered as missing responses (tick the question mark). For any activity the four potential answers are:

- **Impossible (0):** the child is unable to perform the activity without using any other help;
- **Difficulty (1):** the child is able to perform the activity without any help but experiences some difficulty;
- **Easy (2):** the child is able to perform the activity without any help and experiences no difficulty;
- **Question mark:** the parents cannot estimate the difficulty of the activity for their child because he/she has never done the activity.
  - However, if the activity was never attempted because it is impossible, then it must be scored as "Impossible" rather than "question mark".

ABILHAND-Kids evaluation report - rehab-scales.org



http://www.rehab-scales.org/abilhand-kids-rasch-analysis-cerebral-palsy.html



GOAL: Taking off a shirt

MOVEMENTS:
Shoulder flexion

Power Grasp

ACTIVITIES – POWER GRASP:

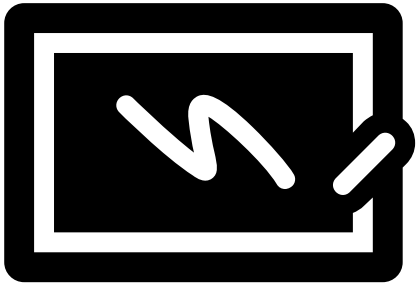
Playdoh - pulling and squeezing

Hold handle of a bucket with affected hand while pouring water in bucket or dropping toys in bucket

Hold jar/bottle with affected hand while therapist pulls lid off jar

Hold toy that interlocks (i.e. block) while therapist pulls block apart

Hold baton or wand during play (i.e. bubbles or drum)



Let's Practice!

Use ABILHAND-Kids to:

1) determine transition zone

2) set goal

3) determine movements and treatment activities

Baby CIMT Programs

Eliasson, Sjostrand, Ek, Krumlinde-Sundholm, & Tendroff. (2014). Efficacy of baby-CIMT: study protocol for a randomized controlled trial on infants below age 12 months, with clinical signs of unilateral CP. BMC Pediatrics, 14:141 doi:10.1186/1471-2431-14-141

Baby-CIMT Manual

Ann-Christin Eliasson and Lena Sjöstrand

Content

Effectiveness of Modified Constraint-Induced Movement Therapy Compared With Bimanual Therapy Home Programs for Infants With Hemiplegia: A Randomized Controlled Trial

Rena Chamudot, Shula Parush, Amihai Rigbi, Roni Horovitz, Varda Gross-Tsur

OBJECTIVE. We examined the effectiveness of modified constraint-induced movement therapy (mCIMT) in treating infants with hemiplegic cerebral palsy and compared therapy outcomes with a nonconstraining bimanual therapy (BIM) of equal intensity.

METHOD. In a single-blinded randomized controlled trial, 33 infants with hemiplegia (mean corrected age = 11.1 mo, standard deviation = 2.2) received either mCIMT ($n = 17$) or BIM ($n = 16$). Both interventions included home programs encouraging the use of the affected hand during daily 1-hr play sessions for 8 wk. Outcome measures were administered pre- and posttreatment and included the Mini-Assisting Hand Assessment for babies and the Functional Inventory. At baseline, parents also filled out the Dimensions of Mastery Questionnaire.

RESULTS. Both groups demonstrated a significantly large and equal improvement in hand and gross motor function posttreatment ($p < .001$) and high treatment compliance.

CONCLUSION. mCIMT and BIM are equally effective methods for treating infants with hemiplegia.

Chamudot, R., Parush, S., Rigbi, A., Horovitz, R., & Gross-Tsur, V. (2018). Effectiveness of modified constraint-induced movement therapy compared with bimanual therapy home programs for infants with hemiplegia: A randomized controlled trial. *American Journal of Occupational Therapy, 72*, 7206205010. https://doi.org/10.5014/ajot.2018.025981

Rena Chamudot, PhD, OT, is Lecturer, School of

DOSAGE = 56 hours

1-hr daily play session with parents 7 days a week for 8 weeks

Research in Developmental Disabilities 72 (2018) 191–201

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journal homepage: www.elsevier.com/locate/redevdis

Research paper

The effectiveness of Baby-CIMT in infants younger than 12 months with clinical signs of unilateral-cerebral palsy; an explorative study with randomized design

Ann-Christin Eliasson[a,*], Linda Nordstrand[a], Linda Ek[a], Finn Lennartsson[b,c], Lena Sjöstrand[a], Kristina Tedroff[a], Lena Krumlinde-Sundholm[a]

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[c] Department of Clinical Neurosciences, Karolinska Institutet, Stockholm, Sweden

DOSAGE = 36 hours
30 min each day, 6 days each week for 12 weeks

Training was provided in the home environment by the parents who received coaching and supervision during
weekly home visits by an occupational therapist.

CIMT for a child under 1 year of age

Videos

End of 1st mCIMT program,

End of 1st mCIMT program (B1)

End of 2nd CIMT program (B2)

Videos

6 month follow-up

Videos

Infant Treatment Example (video)

Videos

MUSC Camp-Based CIMT Program

- **Day Camp CIMT program** started in the Summer of 2001
  - 18 years strong!
- OT and PT students work as camp counselors
  - Camp is part of a community based elective so students receive course credit
  - **CIMT program is provided at no-cost to families**

Questions?

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