



Development and Feasibility of a Kinect-Based Constraint-Induced Therapy Program in the Home Setting for Children With Unilateral Cerebral Palsy

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研究架構

半側偏癱腦性麻痺孩童實證神經復健

機制探討

治療方案

動作策略

感覺

治療師

居家

夏令營

虛擬實境

介入方案



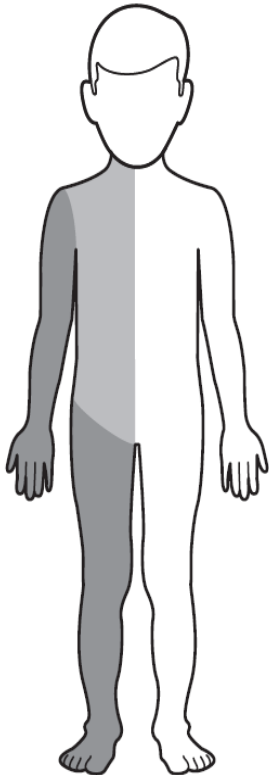


Cerebral Palsy



Hemiplegi

a



29%

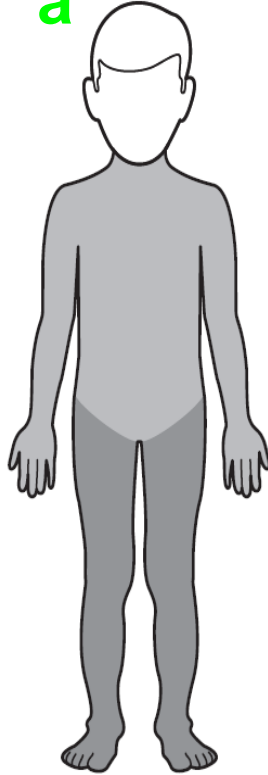


Not affected

(a)

Diplegi

a



32%

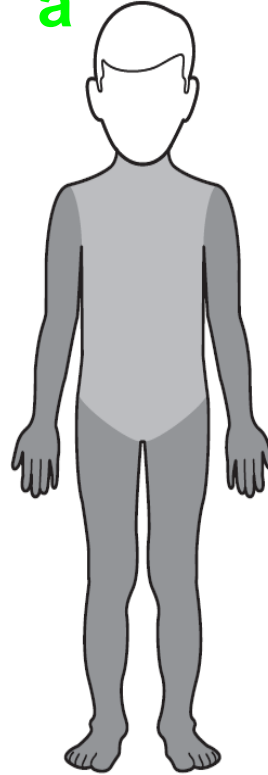


Less affected area

(b)

Quadriplegi

a



24%



More affected area

(c)



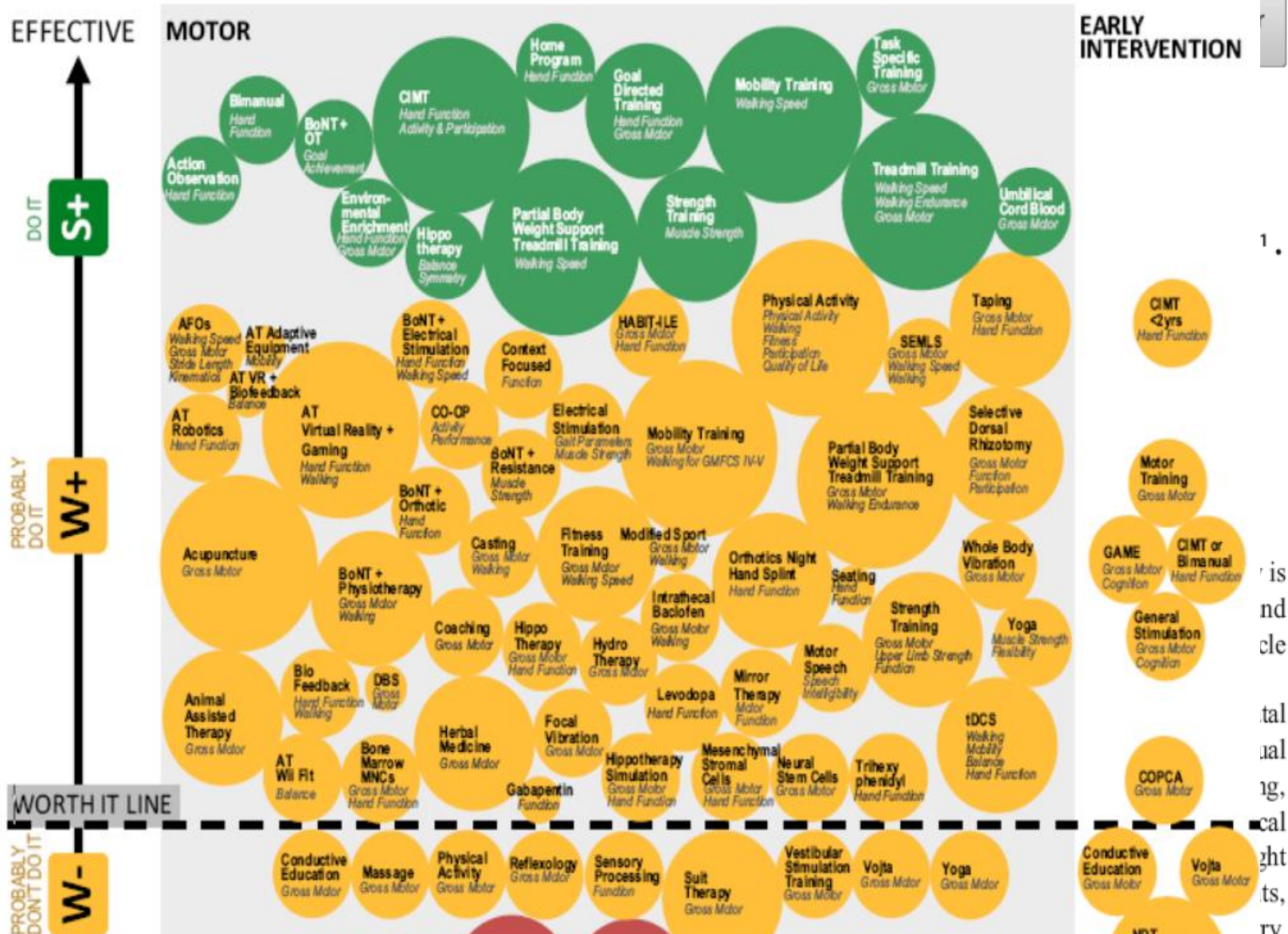


Neurorehabilitation

- Based on the theories of neural plasticity and motor learning
- Constraint-Induced Therapy (CIT)
 - **Restraint** of the **less-affected** upper limb (UL)
 - Intensive structured **training** of the **affected** UL
- Bimanual Intensive Training (BIT)
 - **Bilateral coordination**
 - **Functional bimanual activities**
 - Hand-Arm Bimanual Intensive Training (HABIT)

(Charles & Gorden, 2006; Andersen et al. 2013; Chen et al. 2014; Sakzewski et al., 2014)







Disadvantage of CIT



- Intensive protocol
 - Motivation
 - Labor intensity
- Restraint of less-affected UL
 - Frustration

(Hart et al., 2005; Smania et al., 2009; Gilmore et al., 2010; Lin et al. 2011)



Virtual Reality Rehabilitation

- Intensive protocol
 - Motivation
 - Labor intensity
- Rehabilitation-specific VR system vs. commercial VR system

(Harris and Reid, 2005; Tatla et al., 2013; Chen et al., 2014)





Purposes



- Develop Kinect-based CIT program for children with unilateral CP
- Feasibility study
 - Phase 1: Confirm CIT goals
 - Phase 2: Effectiveness (pilot study)

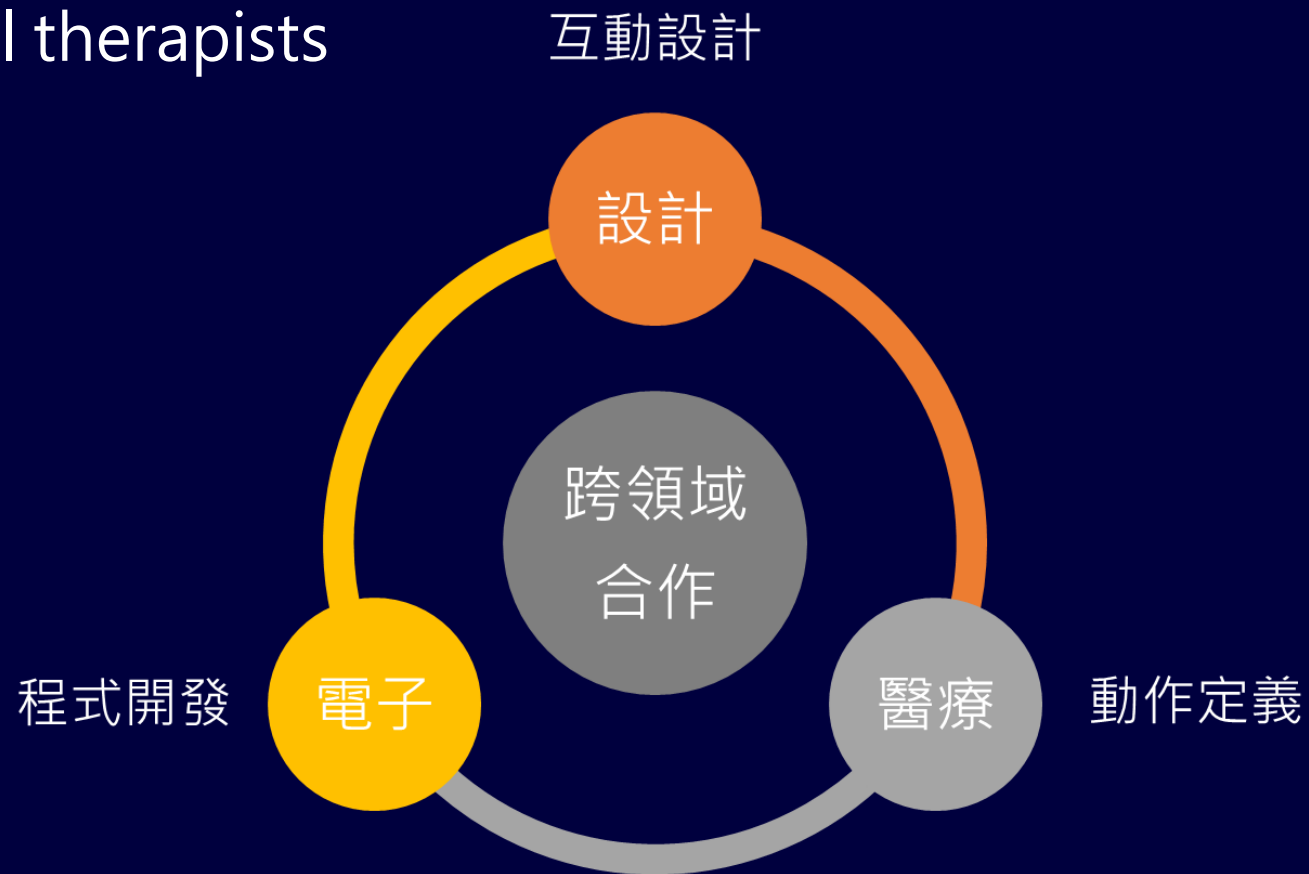




Research Team



- Occupational therapists
- Engineers
- Designer





Integration of CIT Principles

- Motor training goals
- Restraint of less-affected UL
- Intensive structured training of affected UL





Motor Training Goals



- Motor learning training theory
 - External focus
 - Feedback: visual and auditory
 - Intensive training: repetitive practice, random practice
- Shaping skill
- Personalized game difficulties
- User interface

Preparation



reach, grasp and release

Level 1



reach, grasp and release

Level 2



reach, grasp, release and
aim

Level 3



reach, grasp, release, aim
and hold



Restraint

- Game design by motion capture sensor
- Contextual restraint





Feasibility Study

Phase 1



Participants



- Ten Unilateral CP
- 5-12 years old
- No excessive muscle tone (Modified Ashworth Scale ≤ 2 at any joint of the UL)
- No severe cognitive, visual and auditory disorders

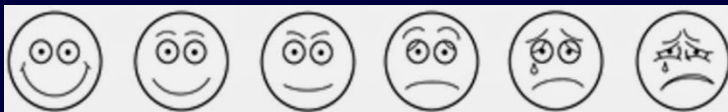


Gameplay

20 minutes



- Achievement of the CIT-specific design
 - Motion capture system: Vicon 13+
 - Kinect 2 sensor
 - Children's perception of playing game
 - Self-developed questionnaire
 - Enjoyability, safety, challenge, acceptability and skill at the game
- (Hanna, 2004)





Results and Discussion



Phase 1



- Achievement of the CIT-specific design
 - Restraint of less-affected UL
 - Intensive training of affected UL
 - Achieve an average of **72** repetitive grasps (range 54–108 repetitions)
 - It is crucial to cause neural reorganization in the brain and improve the learning of motor and functional skills
- Children's experience
 - Positive and safe
 - Prefer Kinect-CIT over regular intervention (75%)



Feasibility Study

Phase 2



Participants



- Eight Unilateral CP
- Receiving an 8 weeks (18 hours) Kinect-based CIT intervention



Potential Effectiveness



- Performance score recorded by Kinect system
 - Raw score/ total score
 - Harder difficulty lead to a higher maximal total score
- The Box and Block Test (BBB)
 - Evaluate manual function
 - 60 sec





Results and Discussion

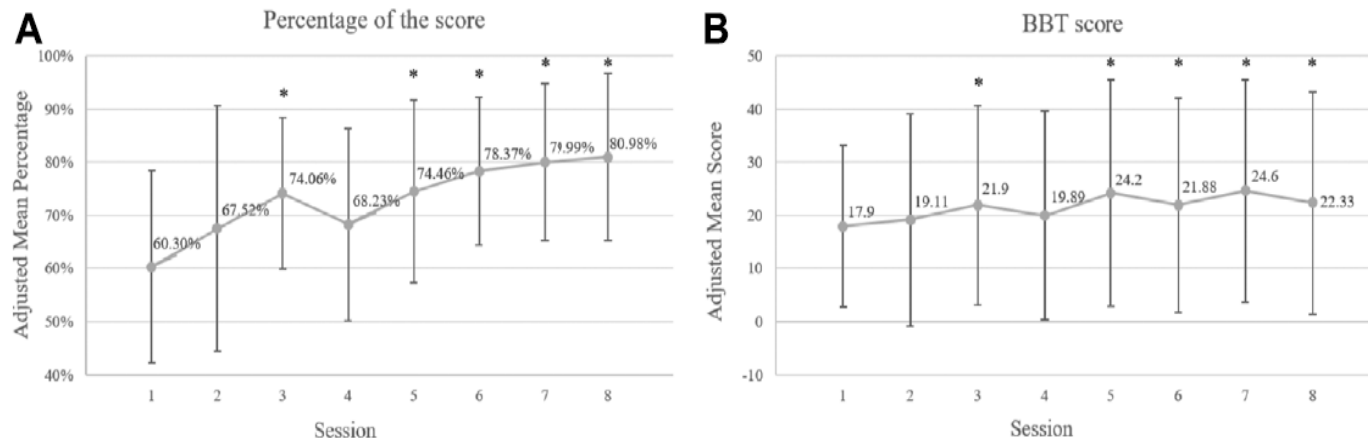


FIGURE 3 | (A) Eight weeks of performance scores of the Kinect game and **(B)** outcomes of the BBT among children with unilateral CP over training sessions.
* statistical significance of $p \leq 0.05$ compared to the baseline.

- Increased stable after 5 weeks of intervention
- Decreased performance from 3 to 4 week
 - Adjust the game difficulty in the 4 week



Clinical Implication and Future Works



- Telerehabilitation
- Comparative effectiveness research
 - Therapist-based and Kinect-based CIT



Thank you for your attention