Mitii™ Australia “Move it to improve it”

A web-based multimodal therapy for children and adolescents with Cerebral Palsy and Acquired Brain Injury

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Disclosure Information

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Louise Mitchell

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I will discuss Mitii™ in my presentation however do not receive funding support from Mitii™ Development A/S.

Roslyn Boyd

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I will discuss Mitii™ in my presentation however do not receive funding support from Mitii™ Development A/S.

Overview of technologies
**Virtual reality**

- Diverse simulation systems
- Allow user to interact in ‘realistic’ manner using computer hardware and software
  
  > “Interactive computer play” any kind of computer game or virtual reality technique where the child can interact and play with virtual objects in a computer-generated environment. (Sundlund, McDonough & Hager-Ross, 2009, p173)

**Classification**

- Immersive
  - First person view of 3D virtual world
  - User wears head mounted display ± force feedback
  - Very expensive, limited to research
- Non Immersive
  - Controlled through 2D flat screen
  - Interact through motion detecting interfaces
  - Vary in cost

**Classification**

- Whole body movement
  - Camera/Video-based capture eg. Kinect, Miti, Playstation EyeToy
  - Sensor-based (remote, glove, platform) eg. Wii, Playstation 3
  - Train combination of whole body skills; ↑ physical activity?
- Upper limb movement
  - Mouse, keyboard, joystick
  - Train upper extremity skills
Describing and classifying (Galvin & Levac, 2011)

- Identified 6 systems
  - Dance Dance Revolution
  - Playstation Eye or EyeToy
  - Wii / WiiFit
  - Gesturetek Interactive Rehabilitation Exercise System (IREX) / GX
  - Paediatric Interactive Therapy System (PITS)
  - Playstation 3 based sensor glove
  - Move it to improve it (Mitii) (Bilde et al., 2011) / Kinect

Dance Dance Revolution

- Availability: Commercially available
- Equipment: Game, console and mat with weight bearing sensors: ~$400
- User: independent standing, stepping & dynamic balance
- Setting: Centre or home based
- Flexibility: Pre-defined games, adjust difficulty
- Measures: Game score and length (Galvin & Levac, 2011)

Playstation Eye / EyeToy

- Availability: Commercially available
- Equipment: Game, console and EyeToy camera: $260
- Interface: User represented in screen environment
- User: From sitting with limited UL movement → independent standing, stepping, balance, full UL
- Setting: Centre or home based
- Flexibility: Pre-defined games, adjust difficulty
- Measures: Game score (Galvin & Levac, 2011)

Wii
- **Availability:** Commercially available
- **Equipment:** Game, console, Wii™ uses remote which detects acceleration, Wii Fit™ uses remote and balance board; ~$330
- **Interface:** User represented as avatar on screen
- **User:** Wii: Requires grasp but can be done sitting
  Wii Fit requires standing & dynamic balance
- **Setting:** Centre or home based
- **Flexibility:** Predefined games, adjust difficulty
- **Measures:** Output in score, time and balance displacement

IREX®
**GestureTek’s Interactive Rehabilitation and Exercise System**
- **Availability:** “Rehabilitation specific” professional system
- **Equipment:** IREX system - TV, green background, Camera, Computer, Red Glove → Camera detects movement: ~$13,000
- **Interface:** User on screen in environment
- **User:** All functional levels
- **Setting:** Centre based
- **Flexibility:** Can adjust parameters of games
- **Measures:** Detailed measurements & therapeutic outcomes

Paediatric Interactive Therapy System (PITS)
- **Availability:** Rehabilitation specific system upper limb reaching and grasp trainer
- **Equipment:** Custom table, pressure sensor gloves or squeeze bottle, computer, TV, PITS software: ?Cost
- **Interface:** Virtual arms on screen in environment
- **User:** All UL functional levels
- **Setting:** Centre based
- **Flexibility:** Can adjust parameters of games
- **Measures:** Detailed data

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Playstation 3 based sensor glove

- **Availability:** Professional tele-rehabilitation system - trains upper-limb and HAND movements
- **Equipment:** PlayStation3, computer, TV, HDMI cables; 5DT Ultra glove – fibre optic sensor per finger
- **Interface:** Hand represented on screen
- **User:** All functional levels
- **Setting:** Centre based
- **Flexibility:** Adjust parameters of games
- **Measures:** Receive detailed measurement (Galvin & Levac, 2011)

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Evidence in children and adolescents with motor disability, including cerebral palsy

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Evidence of low quality

<table>
<thead>
<tr>
<th>Study</th>
<th>Down &amp; Black Score</th>
</tr>
</thead>
<tbody>
<tr>
<td>Chen, 2007</td>
<td>6</td>
</tr>
<tr>
<td>Bad, 2001</td>
<td>7</td>
</tr>
<tr>
<td>Bad, 2006</td>
<td>8</td>
</tr>
<tr>
<td>WiLe, 2008</td>
<td>9</td>
</tr>
<tr>
<td>Yuen, 2005</td>
<td>10</td>
</tr>
</tbody>
</table>

Upper limb function?  
(Galvin, McDonald, Catroppa & Anderson, 2011)

- EyeToy: (n=4) Improved reaching kinematics, visual performance and fine motor performance (Chen, 2007)
- IREX: 3 studies
  - RCT (n=19:12) No statistically significant differences (Pearl & Campbell, 2006)
  - (n=4) Small changes in 3/4 participants (Pearl, 2002)
  - (n=1) Changes in neuroplasticity on fMRI, ↑ motor performance (Reid, 2002)
- PITS: (n=5) 4/5 Improved hand function (Wille, 2009)

Some suggestion that could improve upper limb function

Upper and lower limb?  
(Wang & Reid, 2011)

- Literature review, no assessment of methodological quality
- Upper limb?
  - PlayStation 3 based 5DT Ultra glove: (n=3) Improved ADLs, Jebsen test of hand function (Huber et al, 2008; Golomb et al, 2009)
  - EyeToy: (n=5) Performed target movements, ↑ exercise repetitions and time (Li, 2009); Case:Control (n=5:3) Some improvement on the Melbourne (Jannick et al, 2008)
- Lower limb?
  - IREX: (n=10) ↑ time, hold and range of ankle dorsiflexion (Bryanton, 2006)
    Case:Control (n=3:3) Improved posture during reach & rest (Reid, 2002)
  - Wii: (n=1) Improvements in visual perception (TVPS), reduced postural sway, ↑ ambulation distance (Deutsch, 2008)

As therapeutic modality?  
(Snider, Majnemer & Darsaklis, 2010)

- Conflicting evidence – improvements to body structure & function
- Moderate evidence (1b) – does not improve activity & participation
- Moderate evidence (1b) – positive effect on motivation, volition & self efficacy
Physical activity?
(Mitchell, Ziviani, Oftedal, Boyd, 2012)

- 4 case studies
- Low quality & generalizability

- IREX: (n=4) ↑ walk distance, community balance & mobility. No difference on GMFM-E or up/down stairs (Brien, 2011)
- EyeToy: (n=14) ↑ steps, physical activity & energy expenditure; ↑ Movement ABC. No difference motor proficiency or 1-min walk test (Sundland, 2011)
- Mitii: (n=9) ↑ visual perception, motor and processing skills, functional strength and walking endurance (Bilde, 2011)

Move it to improve it (Mitii™)

- Multimodal web-based training program
- Cognitive, upper limb and physical activity training
- Two types of Mitii
  - 1st generation Green Band Mitii
  - 2nd generation Kinect Mitii
- Aimed to drive neuroplasticity

Example of the Games

1. Figure Ground: Match the puzzle piece onto the screen

2. Visual discrimination: which image does not match with the other images
Why Mitii compared to video games?

Upper-limb training

Cognitive training

Physical activity

Neuroplasticity

Visual perception

Uses internet

Delivered by therapists

Individualised and tailored program

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Mitii

- Designed by Helene Elsass Center and University of Copenhagen
- Log into Mitii website (Cloud technology)
- No costly or special equipment
  - Computer with webcam
  - Green tracking bands
  - Balance foam/ Step block
- 20 week program
  - ~30 mins daily, 6 days/week

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Pilot study

- Pre-post design
- Children aged 9-13 years (n=9)
- Unilateral Cerebral Palsy
- Intensive 30min/day, 20-week training period
- Compliance was high, with an average of 85% of children meeting or exceeding this dose (Bilde, 2011)

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Mitii™ Australia CP Study
- Waitlist Randomised controlled
- n = 98 (49 pairs matched for age, gender and MACS)
- Unilateral CP, 8-18 years, MACS I-III, GMFCS I-II
- Ethics approval
  - UQ Ethics: 2011000608
  - RCH Ethics: HREC/11/QRCH/35

Mitii Australia Acquired Brain Injury Study
- Waitlist Randomised controlled trial
- n = 60
- 12 months post ABI, 8-16 years, Equivalent to MACS I-III, GMFCS I-II
- Ethics approval:
  - UQ Ethics: 2013000212
  - RCH Ethics: HREC/12/QRCH/222

**Open Access**

**Move it to improve it (Mitii): study protocol of a randomised controlled trial of a novel web-based multimodal training program for children and adolescents with cerebral palsy**

Multi-disciplinary studies

<table>
<thead>
<tr>
<th>Overall aim</th>
<th>Occupational Therapy</th>
<th>Physiotherapy</th>
<th>Neuropsychology</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Occupational performance, UL, VP, participation (n=98)</td>
<td>Physical activity</td>
<td>Neuroplasticity and cognition</td>
</tr>
<tr>
<td>1° Hypothesis</td>
<td>↑Occupational performance</td>
<td>↑ Habitual physical activity</td>
<td>↑ Executive function</td>
</tr>
<tr>
<td>2° Hypothesis</td>
<td>↑ UL, VP, participation</td>
<td>↑ strength, PA capacity, function</td>
<td>↑ Use dependant neuroplasticity</td>
</tr>
<tr>
<td>1° Outcome</td>
<td>AMPS</td>
<td>4 day Actigraph HPA</td>
<td>fMRI</td>
</tr>
<tr>
<td>2° Outcomes</td>
<td>JTHF, AHA, MJUL, TVPS, CDPM, LIFE H</td>
<td>Fx strength, 6MWT, MobQues</td>
<td>Executive function, SDQ, BRIEF</td>
</tr>
</tbody>
</table>

Conclusion

- Mitii offers a novel therapy approach
- Regular therapy accessible for children in regional and rural areas
- Keep an eye out for study results and development of Mitii!

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Team Mitii Australia