Interactive technology (FS-16)

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Emerging use of interactive technology in rehabilitation for young people
Speakers

Hilda Mulligan - Otago University, NZ
Jennifer Rowland - Univ. of Texas Medical Branch, US
Marlene Sandlund - Umea University, SE
Parimala Kanagasabai - Otago University, NZ
Joanne Potterton - Univ. of Witswatersrand, SA
Overview

• Current state of play
  – Virtual reality
  – Robotics
  – iPad/android tablets
  – Computerized prompting devices
  – Video modelling

• Potential for application in rehabilitation
• Our research in the field
• Challenges for use with children with disabilities
• Audience participation/Wrap up
Current state of play

• Interactive technology
• Rapidly growing
• Many modes
• New field for youngsters with physical and/or cognitive impairment
Potential for application as a rehabilitation tool

• Youngsters like technology
• Engaging and addictive (appropriate challenge level)
• Motivating (competition and variation)
• Learning/practice without pressure
• Multi participant rehabilitation?
Application of virtual reality for adolescents with severe autism

Hilda Mulligan PhD, PT
Senior Lecturer
School of Physiotherapy
Aimed to:

- Examine virtual reality as a tool for enhancing attention and social skills

- Examine effect on “affect”
  (e.g. repetitive stereotypical behaviour)

Game play = Memory card matching

- Robot (Yujin Robot Co. Korea)
- Smart board
- Traditional cards
Challenging methods!

- Developed suitable playing cards
- Programmed (damn) robot!
- Decided parameters for “game” (setting, context, participants)
- Developed categorisation system for measuring behaviour
  - **Interaction** (Focus- looks at other participant)
  - **Intra-action** (Stereotypical repetitive behaviour)
Results

Focus: Looks at other participant

![Graphs showing observations for Participant 1, Participant 2, and Participant 3]
Results

Stereotypical repetitive behaviour: frequency and duration
Our conclusions:

Virtual reality has potential but presents challenges

• Research
• Implementation

Examples of robotic interventions:
Warren et al (2013); Srinivasan & Bhat (2013);
Jordon et al (2012); Diehl et al (2011);
Wainer & Ingersoll (2011)
In Future ...

- Report child characteristics and level of disability
- Develop standardised ways to measure outcomes
- Address barriers to integrating technology into interventions (access, cost, fear)
- Develop customised technology
- More research more research more research ...
Video Gaming Technology to Promote Health and Fitness Among Adolescents with Disabilities

Jennifer Rowland PhD,PT
Associate Professor
University of Texas Medical Branch
Purpose

• To adapt active video games for use by youth with mobility disabilities for upper extremity use;

• To test the effectiveness of adapted and off-the-shelf games as an alternative form of exercise for this population.
Study Timeline

Phase 1: Adaptation and usability testing
Phase 2: Energy Expenditure (energy cost) data collection
Phase 3: Fitness Trial
Method

Inclusion Criteria

• Ages 13 -17 and 18-26 years
• Lower extremity mobility disability (e.g., cerebral palsy, spina bifida, spinal cord injury)
• Ability to actively move upper extremities at shoulder and elbow
• Use of wheelchair as primary mode of mobility (can be power chair or manual)
• Not currently participating in a regular exercise program
Methods: Summary

- **Phase I**: Conducted focus group sessions with several youth and young adults with disabilities to adapt equipment;

- **Phase II**: Collected energy cost data using V02 metabolic cart (Vmax Encore 29C) for different games to determine low, moderate, high intensity games;

- **Phase III**: Performed feasibility study for low, moderate, and high functioning upper extremity use; Completed separate exercise trial at residential special needs school in a large midwestern city in the United States
Interactive technology in motor control and learning

Marlene Sandlund PhD, PT
Assistant Professor
Umea University
Interactive computer play in rehabilitation of children with sensorimotor disorders: a systematic review

11 electronic databases, 16 Included articles

- **Diagnosis:** cerebral palsy (>60%), autistic spectrum disorder, preterm children, muscular dystrophy

- **Study designs:** 3 small RCT studies, 9 uncontrolled

- **Participants** (median N): controlled 22, uncontrolled 4

*Sandlund et al., Dev Med Child Neurol. 2009*
Results: 13 (80%) of the studies report positive findings

Areas investigated

- **Movement quality**: studies of upper extremity – results inconclusive
- **Mobility**: spatial orientation and wheelchair driving – results inconclusive
- **Motivation and playfulness**: small studies with positive results

Sandlund et al., Dev Med Child Neurol. 2009

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More than 30 articles, 50% interventions, several reviews

• **Diagnosis:** cerebral palsy, developmental coordination disorder, downs syndrome

• **Study designs:** only 1/3 controlled

• **Participants** (median N): controlled 30, uncontrolled 10
**Results:** 75% of the studies report positive findings

**Areas investigated:**

- **Movement control:** studies of gross motor function, upper extremity and hand function – results >75% positive
- **Balance:** results inconclusive
- **Motivation and playfulness:** small studies with positive results
Promising!
- but the evidence is still weak due to small studies and limited quality
Goal-directed arm movements

Study design:

• 15 children with CP, GMFCS I-III
• 6-16 years of age
• 4 weeks home based practice with active video game
• kinematics captured while reaching for virtual and real targets

Sandlund et al., Dev Neurorehabil. 2014
Goal-directed arm movements

Virtual targets (while playing) – more efficient reaching strategy

Real targets (transfer effect) – increased movement smoothness

Sandlund et al., Dev Neurorehabil. 2014
Parents’ perceptions

Facilitate a positive experience of physical training

• Gaming practice promotes motivation
• Physical training becomes a social activity

Promote independent physical training

• Stimulate the child
• Reduce the parental effort

Call for refinements

• Need for control of performance
• Need for individualization
• Wish for an unobtrusive technology

Sandlund et al., Disabil Rehabil. 2012
Clinicians’ experiences

Technology meets clinical practice

• Motivating intervention (+ and -)
• Reward or distraction
• Limited options for individual adjustments
• Cognitive challenges (+ and -)
• Time for practicalities
• Include within home programs

Onus is on the therapist

• Need to become familiar with the technology
• Time for reflection, matching and adaptations

Levac & Miller, Physiother Theory Pract. 2013

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"It is the therapist who is making the success or not"
Affiliation to computer and video games in children with movement difficulties in New Zealand

Parimala Kanagasabai MPT(Paeds)
PhD student
School of Physiotherapy
Aim

• Describe the nature of participation of children with movement difficulties in computer games

• Play experience of children with movement difficulties in computer games
Method

Inclusion
• Children (6 to 12 years) with movement difficulties
• Able to understand simple questions

Exclusion
• Other health conditions (e.g. cancer)
• Behavioural disorders (e.g. autism, ADHD)
Recruitment

• 11 Disability Organizations across New Zealand

• District Health Boards (Auckland & Canterbury) (35 PTs & OTs)*

• Movement Development Clinic

*PTs: Physiotherapists; OTs: Occupational therapists
Procedure

1. Study information sent out
2. Participants expressed interest
3. Questionnaires mailed out
4. Invitation for interview study
Mixed method

Survey

**CAPE** (Children’s Assessment of Participation and Enjoyment)  
*King G.et al. 2004*

- Frequency
- With whom
- Where
- Level of enjoyment

Activity Scale for kids  
*Young NL, 2000*

Interview

- Semi-structured interviews
- Multiple data collection techniques
- Multiple researchers
- Member checks
- Constant comparison analysis
Survey results

Questionnaires sent out – 79
Completed questionnaires – 60
Demographics

No. of participants: 60
Age: 6-12 years
Sex: Male - 41

Diagnosis

- Cerebral Palsy: 27
- Amputation: 7
- Dyspraxia: 7
- Muscular dystrophy: 4
- Spina bifida: 2
- Arthrogryposis: 2
- Others: 11
Participation in Computer and video games

- Play: 95%
- Do not play: 5%
Movement difficulty and Participation

<table>
<thead>
<tr>
<th>Level of movement difficulty</th>
<th>Number of children</th>
</tr>
</thead>
<tbody>
<tr>
<td>Mild</td>
<td>1</td>
</tr>
<tr>
<td>Moderate</td>
<td>31</td>
</tr>
<tr>
<td>Severe</td>
<td>0</td>
</tr>
</tbody>
</table>

- 1 child with mild movement difficulty do not play.
- 2 children with moderate movement difficulty do not play.
- 17 children with severe movement difficulty do not play.
- 31 children with moderate movement difficulty play.

- Children with mild movement difficulty do not play.
- Children with severe movement difficulty do not play.
- Children with moderate movement difficulty either play or do not play.
Frequency of play

- >1 time/day: 56%
- 2-3 times/wk: 22%
- Once/wk: 12%
- 2-3 times/mth: 3%
- Once/mth: 2%
- No: 5%
With Whom?

- Alone: 67%
- Family: 24%
- Friends: 7%
- Others: 2%

Where?

- Home: 88%
- School: 5%
- Relative's home: 5%
- Community: 2%
Level of Enjoyment

Number of Children

<table>
<thead>
<tr>
<th>Enjoyment</th>
<th>Percentage</th>
</tr>
</thead>
<tbody>
<tr>
<td>Love it</td>
<td>77%</td>
</tr>
<tr>
<td>Very much</td>
<td>19%</td>
</tr>
<tr>
<td>Pretty much</td>
<td>4%</td>
</tr>
</tbody>
</table>

Number of Children: 77% love it, 19% very much, 4% pretty much.
Interview results

- 22 participants
  - Christchurch (4)
  - Invercargill (4)
  - Wellington (7)
  - Auckland (6)
  - Dunedin (1)
Creative
“

I love Minecraft...
Well really can build
anything with blocks,
it’s a very creative
game which has
many possibilities.”

Play
indoor

Looks
like real

Multiple
options

“

It’s really
Fun”

Learning
“I’ve got games on it
and stuff ....they’re
all simulators. How
to drive a bus, how
to fly a plane, how
to use a fire engine”

Multiplayer

“

“I am really big fan of
gaming. On the Wii its
multi player so I can
play with friends”

Pass time

“MUMMY
SETS THE
TIMER !!!”
Implications for interactive technology

- Feasible to use with friends and in the community
- Easily available in community programmes
- Creative (for children based on cognitive ability)
- To learn new activities
- Involve physical activity (based on movement abilities)

Funding

- Physiotherapy research Fund Grant in Aid ($2000)
- Pediatric Special Interest Group study award ($1000)
- School of Physiotherapy PhD funding ($1000)

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Challenges for implementing interactive technology in resource poor settings

Joanne Potterton PhD, PT
Senior Lecturer
University of Witwatersrand
There can be no doubt that the use of interactive technology presents some exciting opportunities

BUT

Can “one size fit all”
Considerations in developing countries

- Poor access to home computers
- Poor computer literacy levels
- High cost, low speed, unreliable internet
SES data from an urban SA sample
(Childhood HAART alterations in normal growth, genes and aging evaluation M120871)

<table>
<thead>
<tr>
<th>Characteristics</th>
<th>All HIV+ (N=553)</th>
<th>All HIV- (N=300)</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Sex, N (%)</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Male</td>
<td>255 (46.1)</td>
<td>162 (54.0)</td>
</tr>
<tr>
<td>Female</td>
<td>298 (53.9)</td>
<td>138 (46.0)</td>
</tr>
<tr>
<td><strong>Age, years</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Mean (SD)</td>
<td>6.7 (1.3)</td>
<td>6.8 (1.6)</td>
</tr>
<tr>
<td>Median (IQR)</td>
<td>6.9 (5.6-7.8)</td>
<td>7.0 (5.3-8.1)</td>
</tr>
<tr>
<td>Range</td>
<td>4.0-9.6</td>
<td>4.0-10.0</td>
</tr>
<tr>
<td><strong>Tap, N (%)</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Yes</td>
<td>319 (57.8)</td>
<td>170 (56.7)</td>
</tr>
<tr>
<td>No</td>
<td>233 (42.2)</td>
<td>130 (43.3)</td>
</tr>
<tr>
<td><strong>Toilet, N (%)</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Yes</td>
<td>266 (48.2)</td>
<td>157 (52.3)</td>
</tr>
<tr>
<td>No</td>
<td>286 (51.8)</td>
<td>143 (47.7)</td>
</tr>
<tr>
<td></td>
<td>Yes</td>
<td>No</td>
</tr>
<tr>
<td>--------------------------------</td>
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</tr>
<tr>
<td>Electricity, N (%)</td>
<td>510 (92.4)</td>
<td>295 (98.3)</td>
</tr>
<tr>
<td></td>
<td>42 (7.6)</td>
<td>5 (1.7)</td>
</tr>
<tr>
<td>Television, N (%)</td>
<td>528 (95.7)</td>
<td>292 (97.3)</td>
</tr>
<tr>
<td></td>
<td>24 (4.4)</td>
<td>8 (2.7)</td>
</tr>
<tr>
<td>Computer, N (%)</td>
<td>157 (28.4)</td>
<td>76 (25.3)</td>
</tr>
<tr>
<td></td>
<td>395 (71.2)</td>
<td>224 (74.7)</td>
</tr>
<tr>
<td>Internet, N (%)</td>
<td>226 (40.9)</td>
<td>127 (42.3)</td>
</tr>
<tr>
<td></td>
<td>325 (58.9)</td>
<td>173 (57.7)</td>
</tr>
<tr>
<td>Caregiver paid job, N (%)</td>
<td>278 (50.4)</td>
<td>115 (38.3)</td>
</tr>
<tr>
<td></td>
<td>273 (49.5)</td>
<td>185 (61.7)</td>
</tr>
</tbody>
</table>
But.......... 

• Rapidly growing use of cell phones. In SA more people have access to a cell phone than to clean water! 

• Cell phone apps are being used with increasing frequency in health care in developing countries 

• Smart phones and tablets allow for more sophisticated interaction
Don’t forget the therapists!

• How can we use technology to support therapists in rural under-resourced settings?

• What about the techno-dinosaurs?
The challenge going forward…..

• We need to be creative
• Consider low cost options as well
• Ensure our services remain accessible and appropriate to the needs of all disabled children.
• Don’t further marginalise the most vulnerable in society.
Audience participation

Parimala

Jennifer

Hilda

Joanne

Marlene