Interaction Design for Rehabilitation

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Intelligent User Interfaces
Limassol
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Economics of healthcare

Health care spending has grown much faster than the rest of the economy in recent decades.


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Interactive rehabilitation technologies

↑ Training intensity
↑ Training variety
↑ Patient independence
↑ Patient engagement
↓ Reduced workload for clinical staff
↓ Reduced cost
Motor and behavioural learning

CP games on TagTiles board

1. **The Hungry Monster**

Yellow squares appear randomly on the board.

The patient is grasping an object (monster) which «eats» the yellow squares.

Trains: Grasps, elbow and shoulder extension, wrist flexion and extension.
CONTRAST: Gamification of Arm-Hand Training for Stroke Survivors

REHAP Tiles (UTS)

REHAP feedback
Skill recovery after stroke

Stoke

Acute

Subacute

Chronic

Spontaneous Recovery

Haematoma resorption
Elevation of diachisis

True recovery
movement involves same muscles

Functional brain map reorganisation
Use of pre-existing CC-connections, increased activity perilesional area
Nerve fibre sprouting & synaptogenesis
Increase synaptic efficacy

Compensation
movement involves different muscles

Increased activity in the undamaged ipsilateral hemisphere

Reversal of maladaptive biomechanical changes

Increase Joint ROM
Improve Coordination
Increase Muscle force

Movement Affected Arm and Hand

SotA in rehabilitation technology

• To date no effect on activity level
  (Prange 2006, Kwakkel 2008, Mehrholz 2009)

• Reasons:
  – stimulus-response discrepancy
  – proximal OR distal approach
  – lack of real life sensory input
  – limited degrees of freedom, limited reach
  – cognitive problem solving processes related to real life activities were not enough challenged
SotA in rehabilitation technology

...Technology for upper limb training needs to provide engaging, patient-tailored task-oriented arm training in natural environments with patient-tailored feedback that supports learning of motor skills (Timmermans et al 2009)....

...essentially an HCI challenge
TagTrainer

Therapists as content creators

Usage of TagTrainer
RES: posture monitoring during training

Developing wearables for rehabilitation
connecting with smart device by bluetooth
Bootsman, Markopoulos, Qi, Timmermans, Posture correction for occupational low back pain prevention with smart garments, Submitted. (2016)
Bootsman, Markopoulos, Qi, Timmermans, Posture correction for occupational low back pain prevention with smart garments, Submitted. (2016)
Cervic Gear
Luca Giacolini, graduation project 2016
TU/e Industrial Design 2016
Posture pillar, Mantas Palaima, M1.1 project, Industrial Design
Interaction design process

1
• Immersion in context of clinic
• Learning from existing therapy
• Co-design

2
• Iterative design
• Stepwise increase testing realism

3
• Acceptance/Experience /Credibility/Expectancy
• Observation
• Pre-clinical testing
Feedback Design

• Content
  – Knowledge of results versus knowledge of performance
  – Emphasis on successful performance

• Scheduling
  – Less is more, fading out

• Modality
  – Multimodal, stepwise, contextualised, customised
Challenges for human computer interaction

• Equity for multiple stakeholders
• Participation and community
• Organisational and legal constraints
• Ethics of patient participation
• Effectiveness of yesterday’s technology
• Implementation in clinical settings
• Adapting feedback and coaching to patient behaviour
• Sustaining engagement in the long run
Credits

I. Politis, A. Goulati, B. Dhillon, A. Racewska, N. Chupriyanov (CP GAMES)
D. Tetteroo (TAGTILES)
A. Jacobs, A. Antal (CONTRAST)
A. Timmermans, R. Winters (Scribeo)
M. Willems (CervicWare)
Q. Wang, Jiachun Du, Qi Qi (Zishi)
R. Bootsman (Back Up)
V. Donker, B. Bongers (Rehap)
Bruna Goveia de Roha, Oscar Tomico (Flow)