Tele-Rehabilitation: A Well-Balanced Approach

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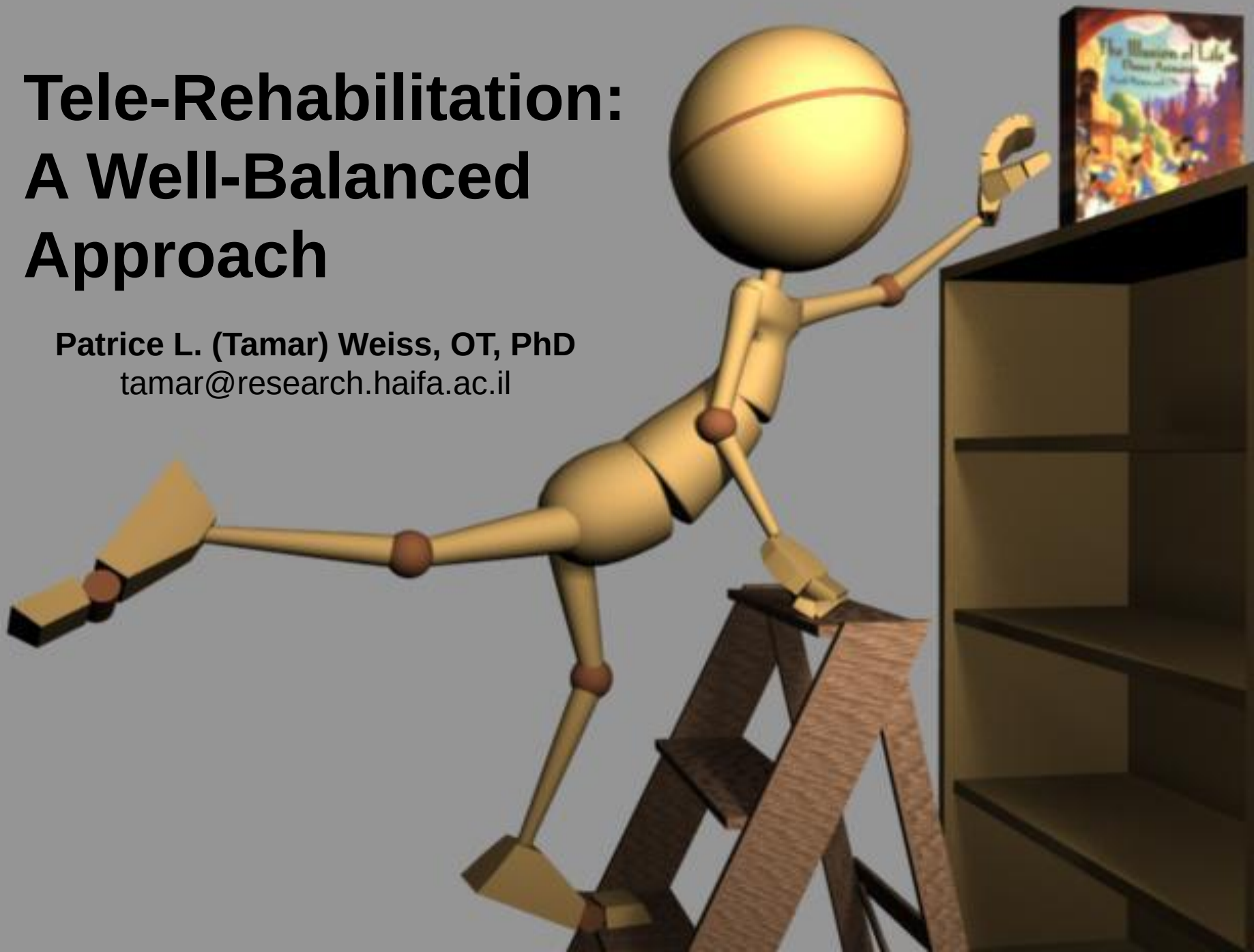

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http://www.gertnerinst.org.il/e/

ReAbility online
movement & language rehabilitation

אוניברסיטת חיפה
University of Haifa
جامعة حيفا
Faculty of Social Welfare and Health Studies
Department of Occupational Therapy

Laboratory for Innovations in Rehabilitation Technology

The Gertner Institute
For Epidemiology and Health Policy Research

LINKS Learning in a NetworKed Society

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Today's Health Care Dilemma

Increased prevalence of Acquired Brain Injuries (e.g., stroke, head injury)

40% left with mild-moderate disability; 5% to 30% left with severe disability

More people survive a stroke, but unless they receive **intensive rehabilitation** they are unable to return to a healthy, independent life style.

Funding for intensive, long-term rehabilitation is **insufficient** to meet the current needs →

Rehabilitation often **terminated before** full recovery

Primary Goal of Tele-Rehabilitation

To expand the **continuity of care** for persons with disabling conditions →

to achieve more successful equilibrium between what clients need & **what health services can reasonably afford**

Aims not to replace conventional therapy→

rather to **enhance duration and intensity** of intervention in a manner that complies with ongoing economic constraints

Last decade has witnessed a significant growth of tele-rehabilitation

Hardware and software developments:

- Robotics
- Virtual Reality
- Collaboration technologies

Literature has demonstrated **feasibility** of remote delivery of motor, cognitive and language treatment

But studies demonstrating **effectiveness** continue to be elusive

Past efforts focused on modifying face-to-face intervention for remote delivery

Current research is focusing on more fully exploiting affordances of low-cost, ambient technologies to achieve a well-balanced intervention

Due to time limitations, today's objective is to present just a few **"lessons learned"** to illustrate need for:

- User-centered design
- Validation of technology
- Effectiveness

3D Motion Capture “Revolution”

Virtual Reality Assets

Microsoft Kinect Sensor

3D depth sensors

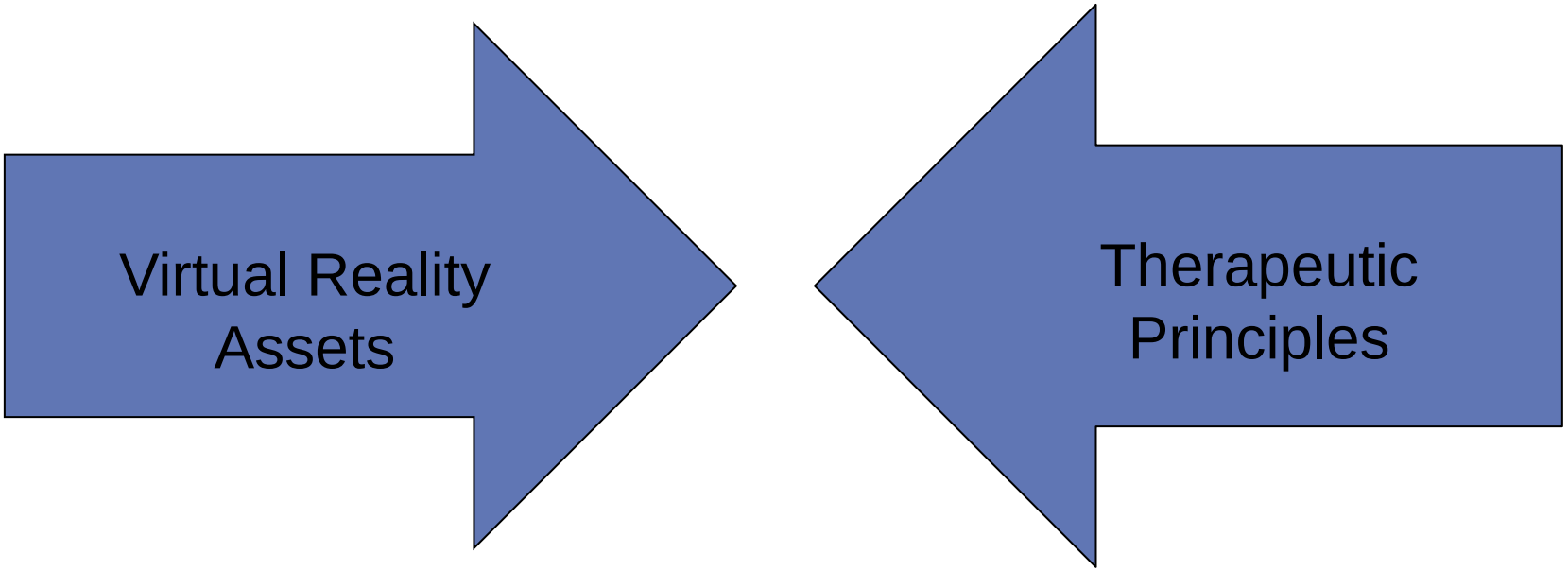
RGB camera

Multi-array mic

Motorized tilt

- Motivation (gaming)
- Easy to grade cognitive and motor levels of difficulty
- Safe and convenient
- Documentation
- Dynamic

3D Motion Capture “Revolution”

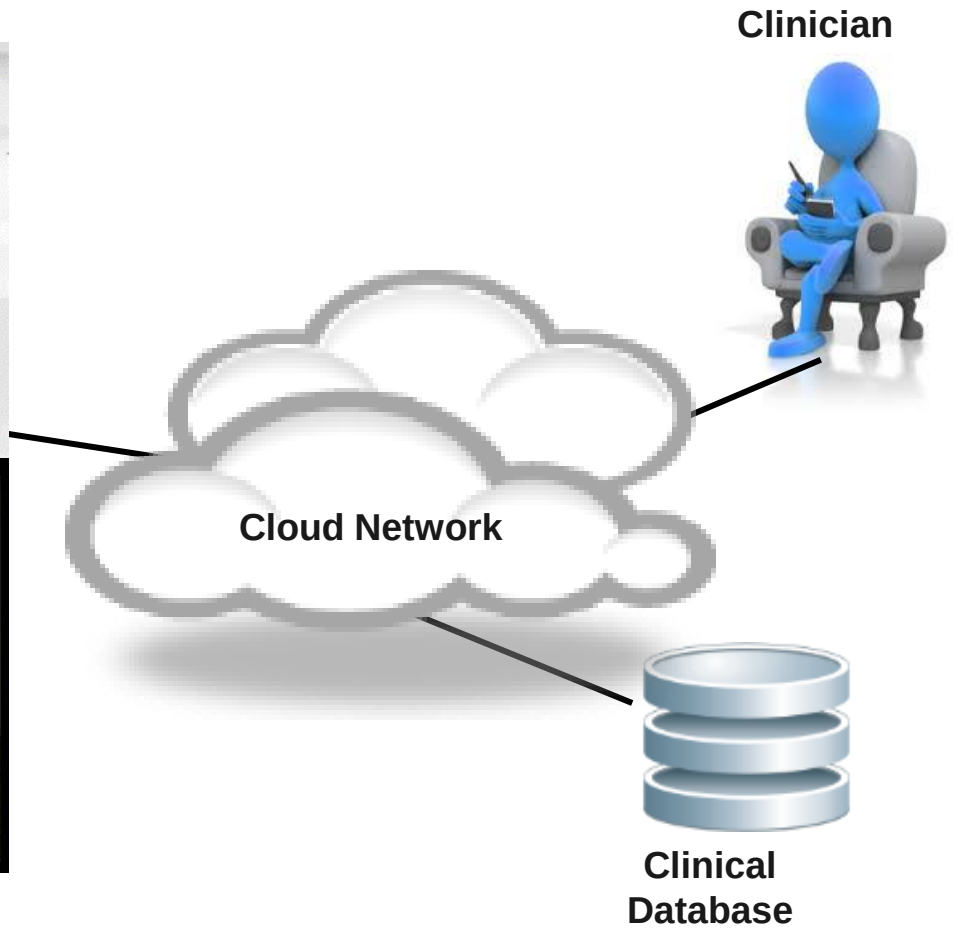


- Motivation (gaming)
- Easy to grade cognitive and motor levels of difficulty
- Safe and convenient
- Documentation
- Dynamic

Even though its off-the-shelf, it also has an SDK

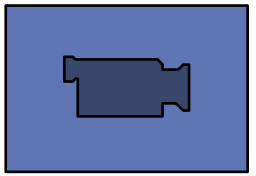
- Exergaming
- Knowledge of results
- Knowledge of performance

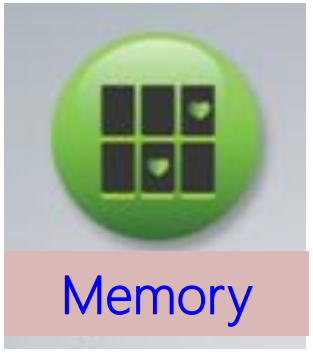
ReAbility Online Tele-Motion-Rehab System

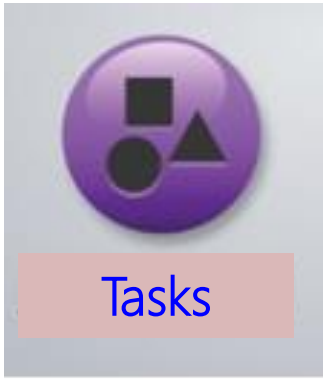


- Kinect camera & Microsoft SDK for tracking of 7 virtual markers
- Designed initially for upper extremity motor & cognitive therapy for people with stroke who are community dwelling but used with other ABI and some orthopedic conditions; lower extremity now also used

Game/Task Menu







Attributes of Technology for Tele-Rehabilitation

Task-specific practice

High intensity, repetitive exercise

Knowledge of performance & results

Activities that can be graded to be demanding but feasible

Motivating

Increased client participation

Applies science-based therapeutic principles of rehab intervention

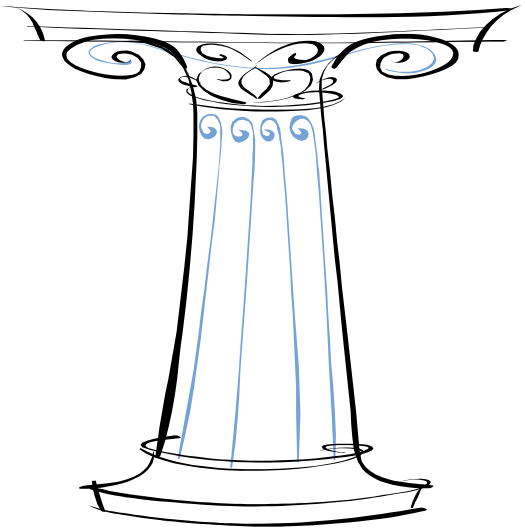
Varied, meaningful & purposeful environmental contexts

Data also available offline for subsequent interpretation by clinician

Three pillars that are needed to justify adoption of tele-rehab technologies

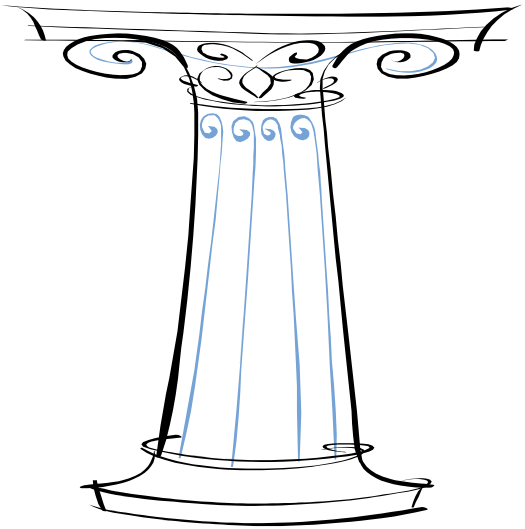
Usability studies

via user-centered design, social ecology & focus groups



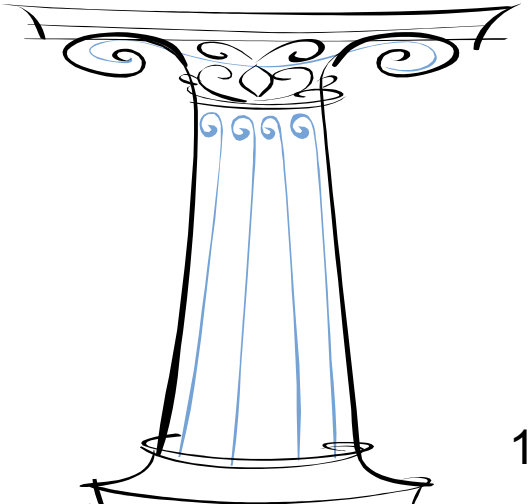
Validation studies

to demonstrate accuracy & validity of technology

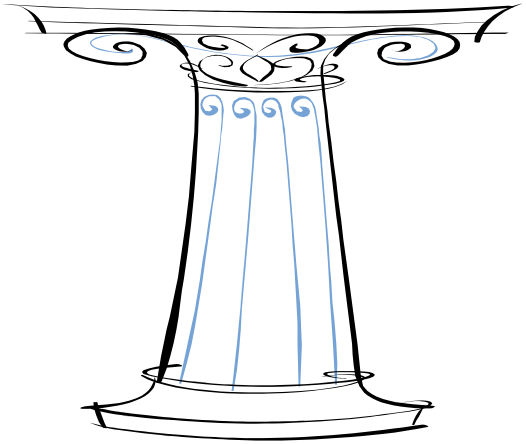


Effectiveness studies

via Randomized Controlled Trials

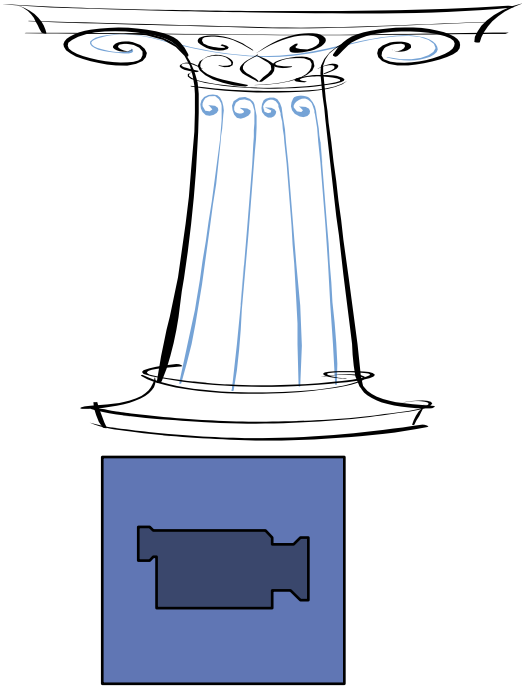


Usability studies



- 3 one-hour sessions in a hospital-based mock-up “tele” setting using tele-games requiring U/E reaching motions
- Short Feedback Questionnaire (mean ± SD = 4.6 ± 0.52
- Borg Scale (mean ± SD = 9.9 ± 2.4) = mild-moderate effort
- Good range of the performance scores during games → sensitive to different levels of ability
- Excellent satisfaction + constructive criticism from Focus Group (e.g., contact when less compliant)

Usability studies



Kizony, R., Weiss, P.L., et al.. Development and validation of a tele-health system for stroke rehabilitation. International Journal on Disability and Human Development, Aug, 2014.

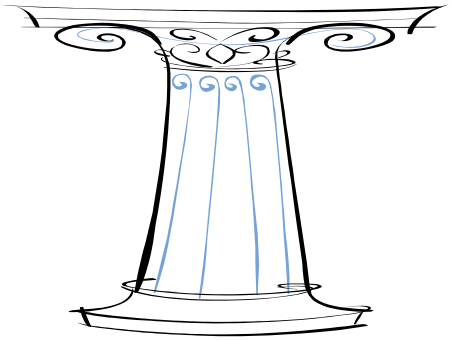
Feedback from clients

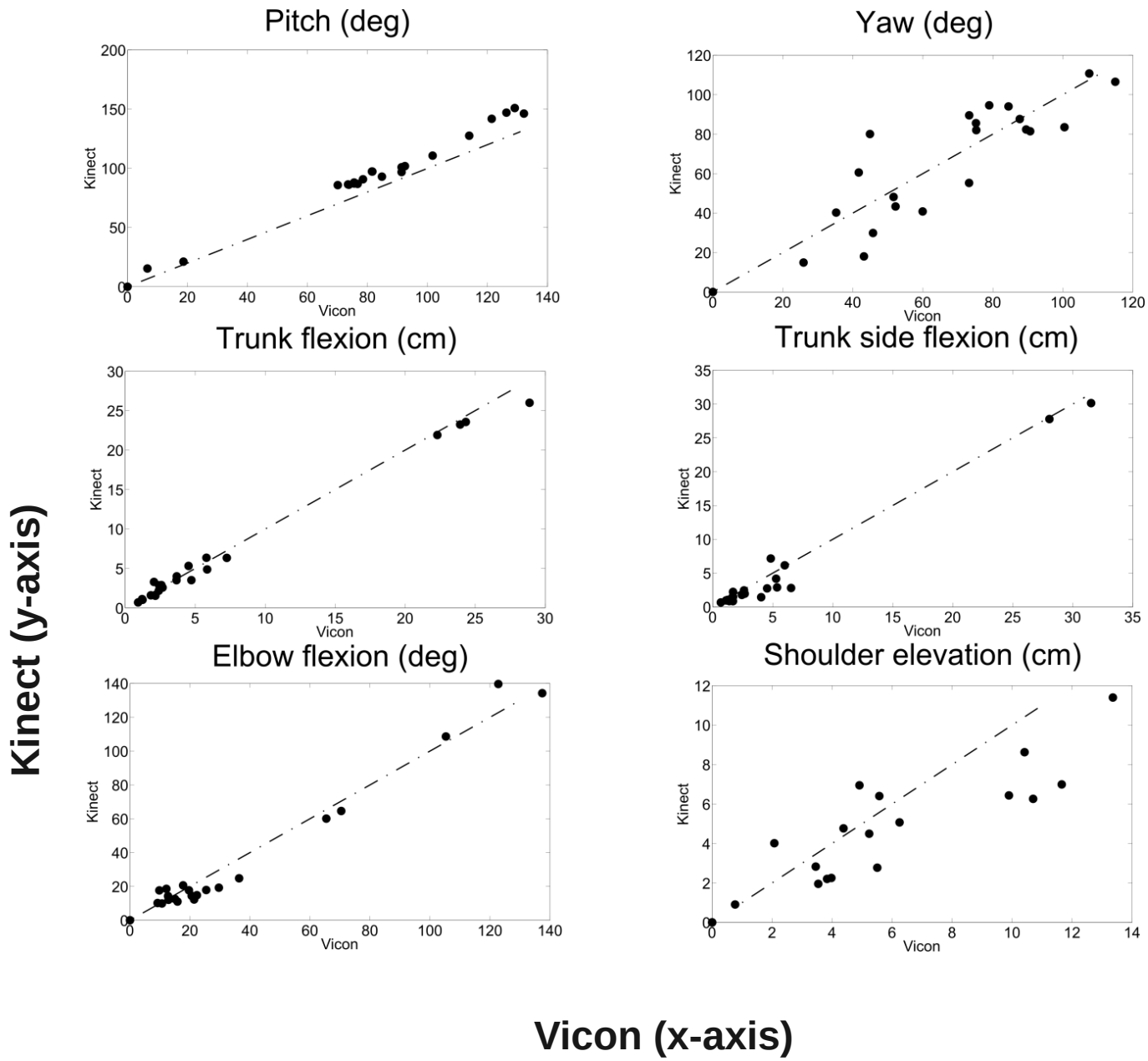
"It has been several years since my stroke. Since then I felt that my left hand was no longer part of my body.

For the first time in years [now that I am getting therapy with the Gertner Tele-Motion-Rehab system], I have regained the use of my left hand and feel it again!

I can now use it to hold light objects, eat with a fork and do other daily tasks. Until a few weeks ago, I simply had to avoid these activities."

Validation studies





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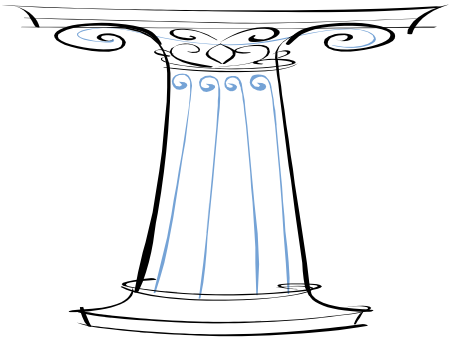
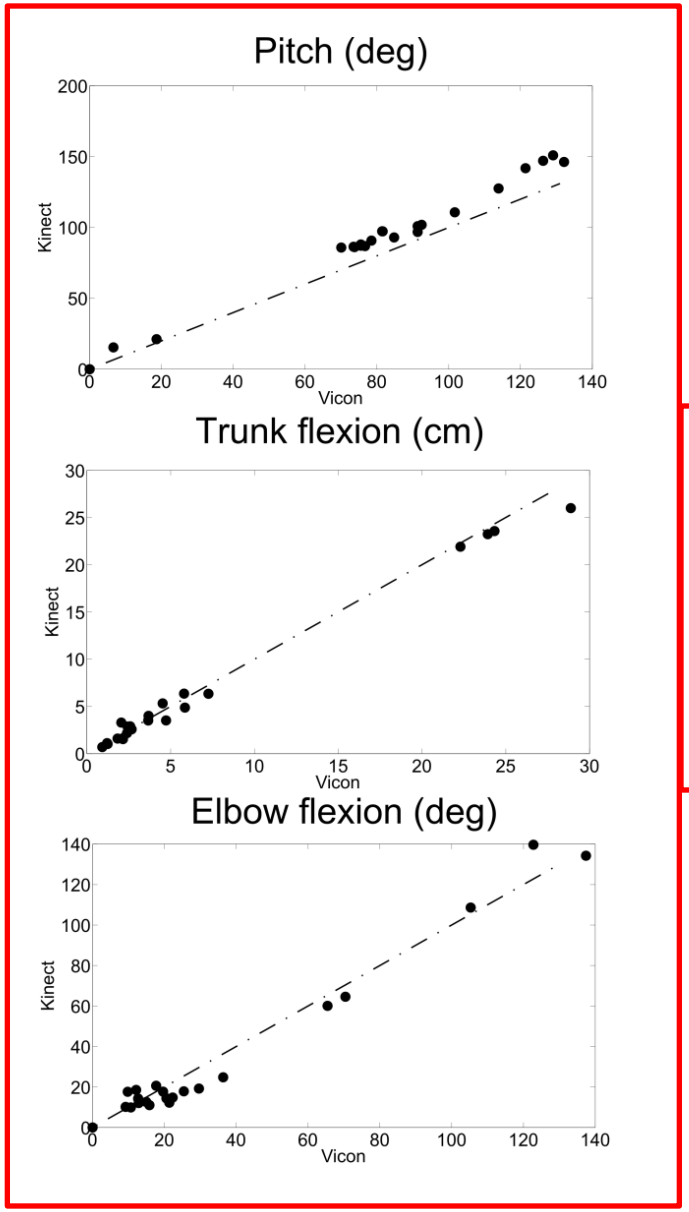


Kinect accurate for:

- Shoulder “pitch”
- elbow flexion
- trunk side & forward flexion



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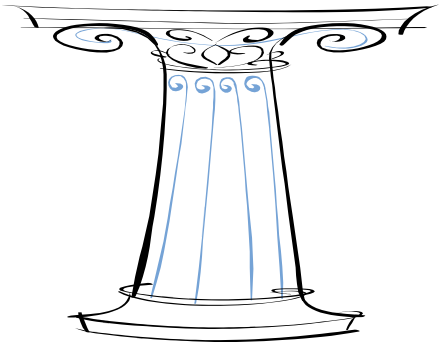
Effectiveness studies



Pre-Post-Follow-up; Single blind design

Assessed for eligibility (n= 100)

Excluded (n=80)
- ¨ Not meeting inclusion criteria (n=62)
- ¨ Declined to participate (n= 13)
- ¨ Other reasons (n= 5) (3 did not return call, 2 involved in other research study)

Randomized (n=21)

12 sessions (3/wk for 4 wks)

Allocated to TELE intervention (n=11)
- ¨ Completed intervention (n=10)
- Taken out (n=1)

Allocation

Allocated to Conventional intervention (n=10)
- ¨ Completed intervention (n=9)
- Withdrew (n=1)

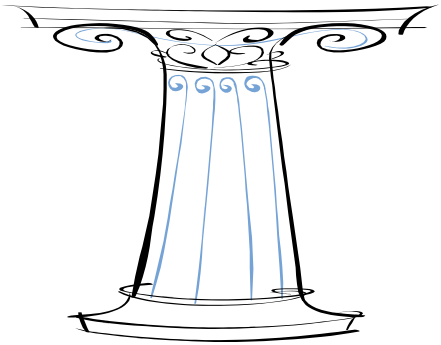
Analysed (n=10)

Analysis

Analysed (n=9)

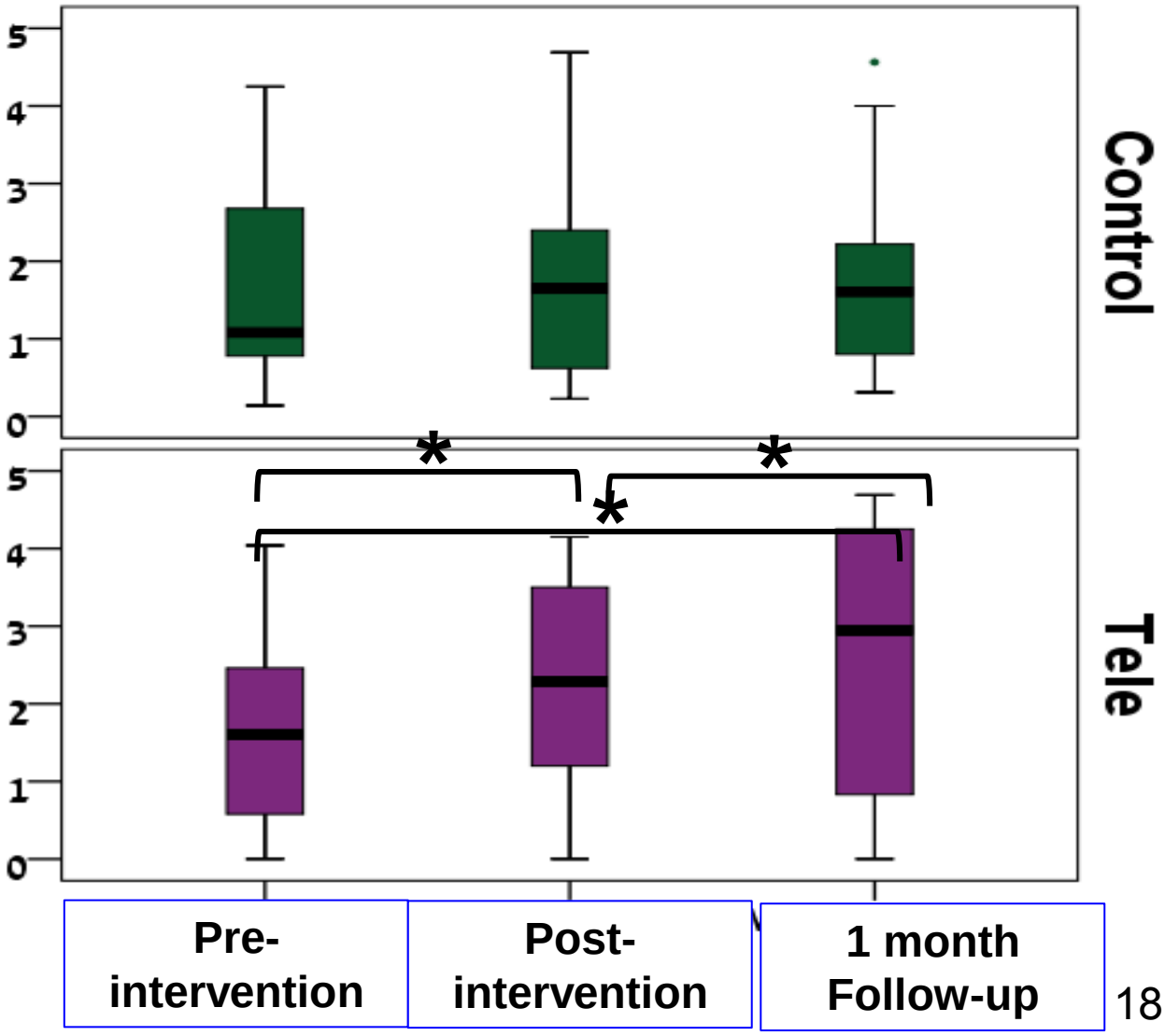
Assessments before, after and 1 month follow-up

Effectiveness studies



Significant differences for Tele Group only

Results: Motor Activity Log - Quality



Kizony, R., Weiss, P.L., et al. Evaluation of a tele-health system for upper extremity stroke rehab-ilitation. Proc 10th Int Conf on Virtual Rehabilitation, Philadelphia, Aug. 2013

Positive results from clinical research

System is easy-to-use & enjoyable by clients

High compliance compared to conventional home exercise

Highly positive feedback from clinicians

Used by more than 150 at-home clients; use continuing to grow

So what are the "Lessons Learned" for Tele-Rehabilitation?

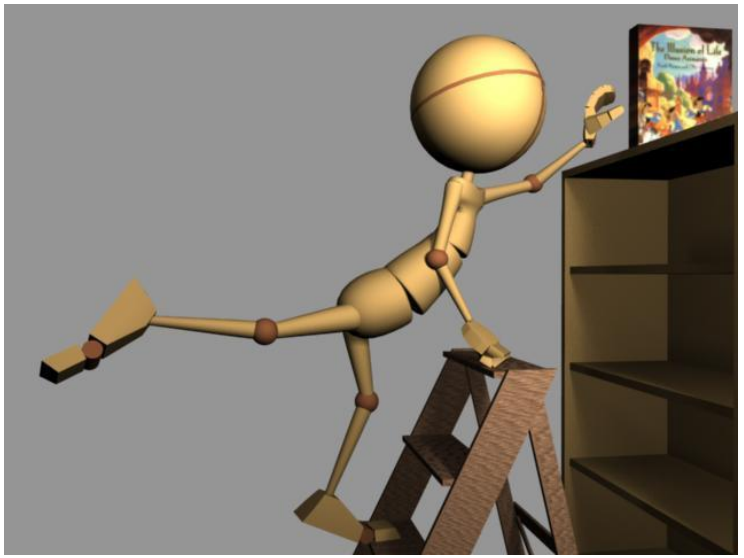
1. When to start and when to stop the technology development process, especially for research?
   - Technology waiting game….

2. Need for research "baby steps" to be able to test when the system is not yet perfect, e.g.,
   - tele "home-mockup"
   - algorithms to avoid inaccurate ROM

3. Centrality of formative and validation studies in preparation for & execution of clinical evaluation studies

4. Stay "true" to clinical principles and objectives even when tempted by "not-yet-mature" technologies (e.g., must have compensation feedback)

Is a well-balanced approach all that is necessary?



Consider Tele-Rehabilitation as a Stretch Target

A target which is currently out of reach, but not out of sight

It may require the breaking of previous boundaries and constraints

Acknowledgements

Technical Development Team

& Clinical Team

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rehabweek
valencia '15

June 9-12, 2015
Valencia, Spain

Valencia RehabWeek 2015

http://virtual-rehab.org/2015/

ICVR 2015

International Conference on Virtual Rehabilitation

ICRAN2015
June 11-12, Valencia, Spain

INRS 2015
International Neurorehabilitation Symposium