

Telerehabilitation Using a Game-Assisted Repetitive Task Practice Platform to Improve Upper Extremity Function after Stroke: Feasibility Study

Tony Szturm¹, PT, Ph.D.,
Zoya Imran¹, PT, M.Sc.,
Sepideh Pooyania^{1,2}, MD. FRCPC,
Anuprita Kanitkar¹, PT, M.Sc.



UNIVERSITY
OF MANITOBA

¹ College of Rehabilitation Sciences, University of Manitoba.

² Attending Physician Stroke Rehabilitation Unit, Riverview Health Centre

³ Department of Neurology Christian Medical College, Ludhiana, India

Supported by Riverview Health Centre Research Foundation, Winnipeg Manitoba

PROBLEM

- Stroke Clients clearly benefit from intensive inpatient & outpatient therapy.
- While one-to-one, supervised therapy is the preferred form, due to access and financial barriers, many do not have this option.

SOLUTIONS TO BE EVALUATED

Telerehabilitation - to Increase accessibility of cost-effective therapy for rehab of upper extremity, and monitored /supported by clinician.

Increase focus and participation - interactive & engaging exercise through fun game-based activities, i.e. game-assisted repetitive task practice (RTP).

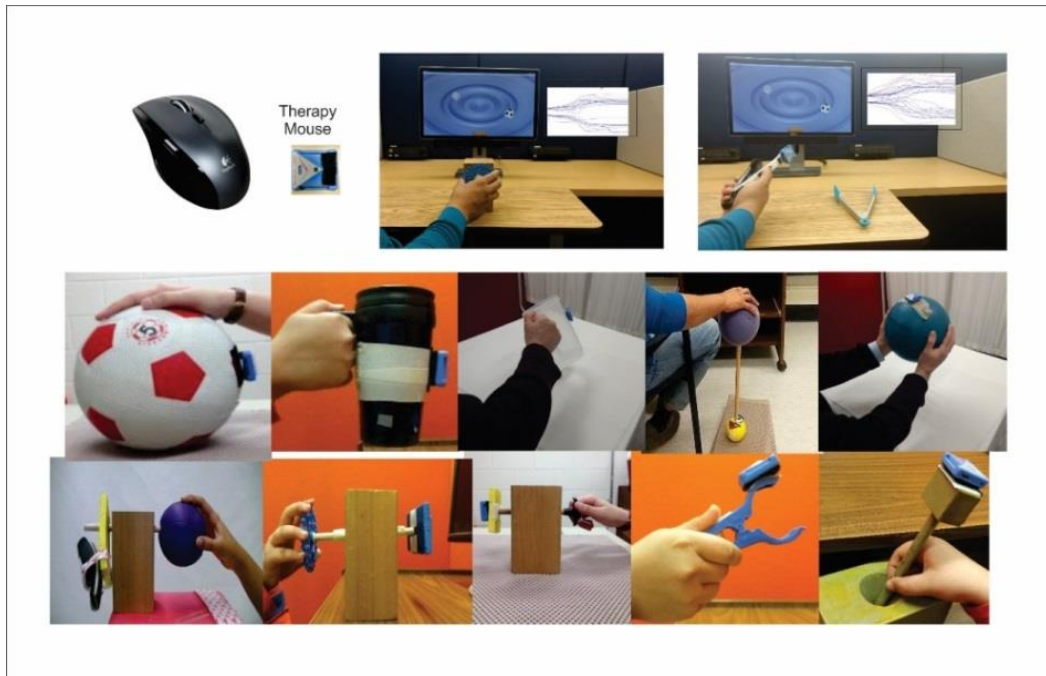
Telerehabilitation Platform Game-Assisted RTP

**Miniature inertial-based mouse can be easily attached with Velcro to many objects
Can Increase the physical and functional demands of object manipulation tasks using:**

- Different physical properties (weight, size, & changing surface friction)
- Increase -degrees-of-freedom (i.e. multiple axis of rotation/TORQUE)
- Tasks that require 2-finger, 3-finger, whole hand or bimanual
- Tasks that require a combination of wrist and/or elbow & shoulder motion

The Training program can also be progressed by

- Adjusting movement precision by changing (target/paddle size).
- Adjusting movement speed of game objects
- Decreasing mouse sensitivity to increase movement amplitude
- Increasing sensitivity to accommodate fine movements

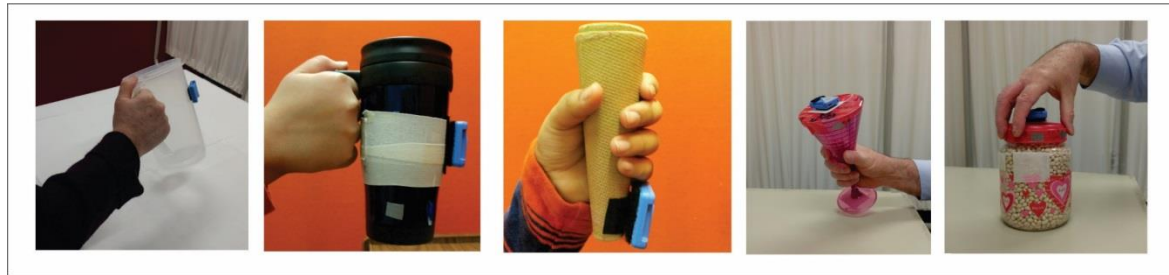


EXAMPLE EXERCISES

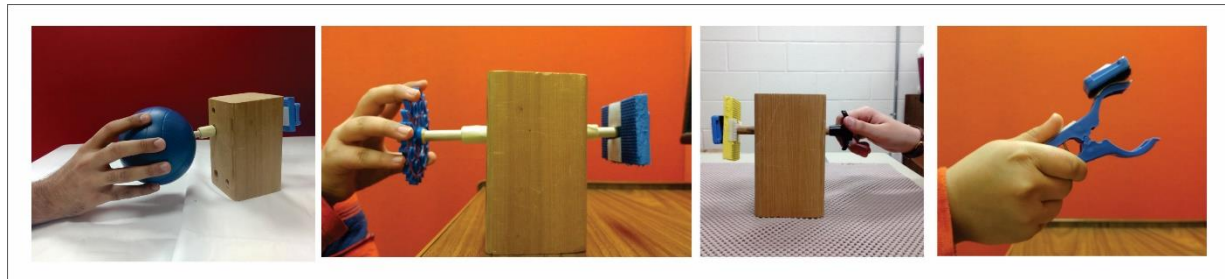
Many different types of bimanual and gross motor tasks can be used
Tasks require Open hand with palmer surface contact and to promote finger extension.



Grasp with different shapes /weights
For pronation-supination & ulnar-radial deviation.



Fine control and while handling small & large objects (2-/3-finger, whole hand)
Large plastic clothes Pin for resisted-assisted thumb motions.



Feasibility Study Participants

- 10 stroke clients who suffered a single CVA
- Age 59 ± 12
- Time since stroke 14 ± 5 months
- Spasticity at wrist/fingers grade 1 to 2.
- 7 did not have any active finger extension
- Wolf motor function test (WMFT)- Total Time:
Group Average at baseline was 250 sec. (± 100)
- WMFT performance score :Group average at baseline was 42 (± 11)
- Grip Strength: Group Average at baseline was 11 (± 5)

RTP-Game Exercise Program

Each Participant Received 4-5 therapy sessions to

- Implement an individualized game-based exercise program,
- teach clients how to use the motion mouse and computer games

Therapist set-up participant laptop computers, installed games / mouse

A variety of exercise objects (with Velcro) were given to each participant

Home program: 16 weeks, 4 times per week and 30 minutes per session.

Qualitative Analysis

Participant experiences during the intervention were explored using semi-structured interviews and the qualitative description approach.

Quantitative Analysis (estimation of benefits)

- Wolf motor function test (WMFT)
- Grip strength
- Computerized assessment of object manipulation tasks.

Feasibility

- 8 of 10 participants fully complied with the 16-week exercise program
- 5 asked to keep the motion mouse to continue their exercise program. .
- 2 participants had difficulty with the gaming/computer operations and hence did not complete the program

Qualitative Analysis :Common Responses From Interviews

“4 training sessions were very helpful in teaching me what exercise to perform and how to use the motion mouse and games.”

“Once I got the hang of it then it was quite easy to run the games and use the motion mouse. The hard part was handling and manipulating the exercise objects.”

“It was helpful for the therapist to set up my computer and the games I used for the exercise program.”

“Exercise program was challenging, and, flexible.”

“There were a number of games I could choose from; some games I liked, they were engaging and made me concentrate and some games I did not like.”

“The mouse drifted sometimes and I had to stop.”

“Had some difficulty with moving mouse from one object to another (i.e. Velcro)”

“Regular feedback a with the therapist on performance and ideas on how to progress the exercise was very important.”

Quantitative Findings

- For the 8 participants who completed the program there was a substantial improvement pre- to post-intervention in the WMFT, and performance of the various manipulation tasks
- WMFT total time- group average at baseline was 250 (± 100)
Average change pre to post was 60 secs(25%)
- WMFT performance score- group average at baseline was 42 (± 11)
Average change pre to post was 9 (22%)
- Grip Strength - group average at baseline was 11 (± 5)
Average change pre to post was 3.5 (31%)

Object manipulation skills (contextual analysis)

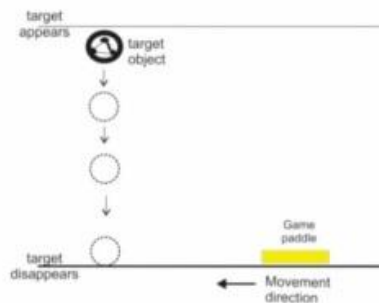


2. Target Game mode

Example Game Configuration

- Sphere large dots is game "Target. object
- Sphere small dots is "Distractor. object
- Goal move paddle catch Target avoid Distractor
- Duration of each game event is 2 seconds

Game Snapshot



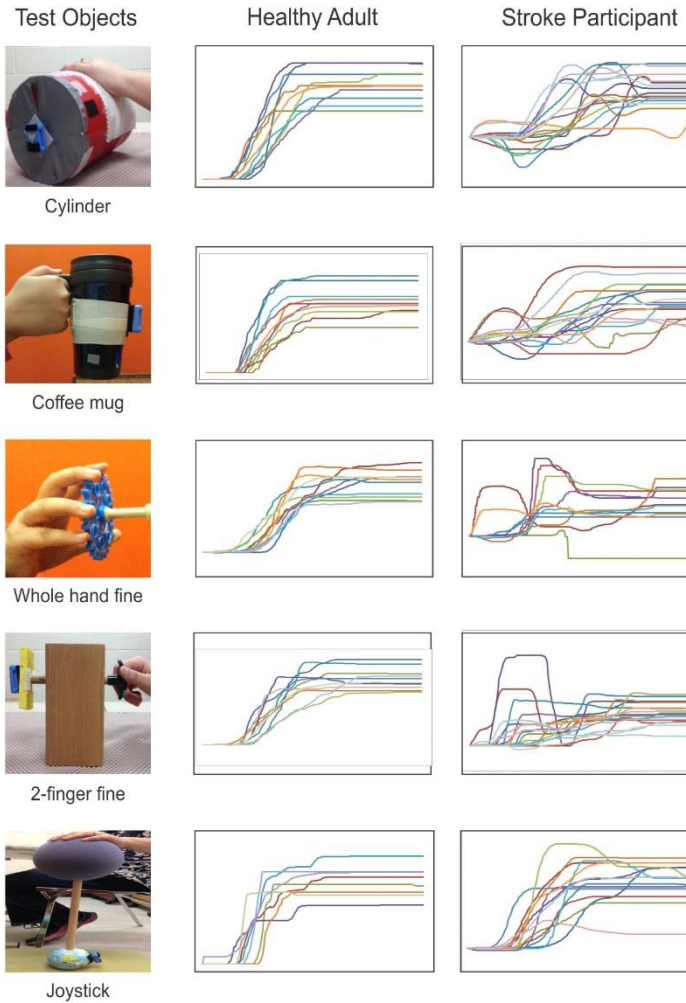
Player movement trajectory for one game event



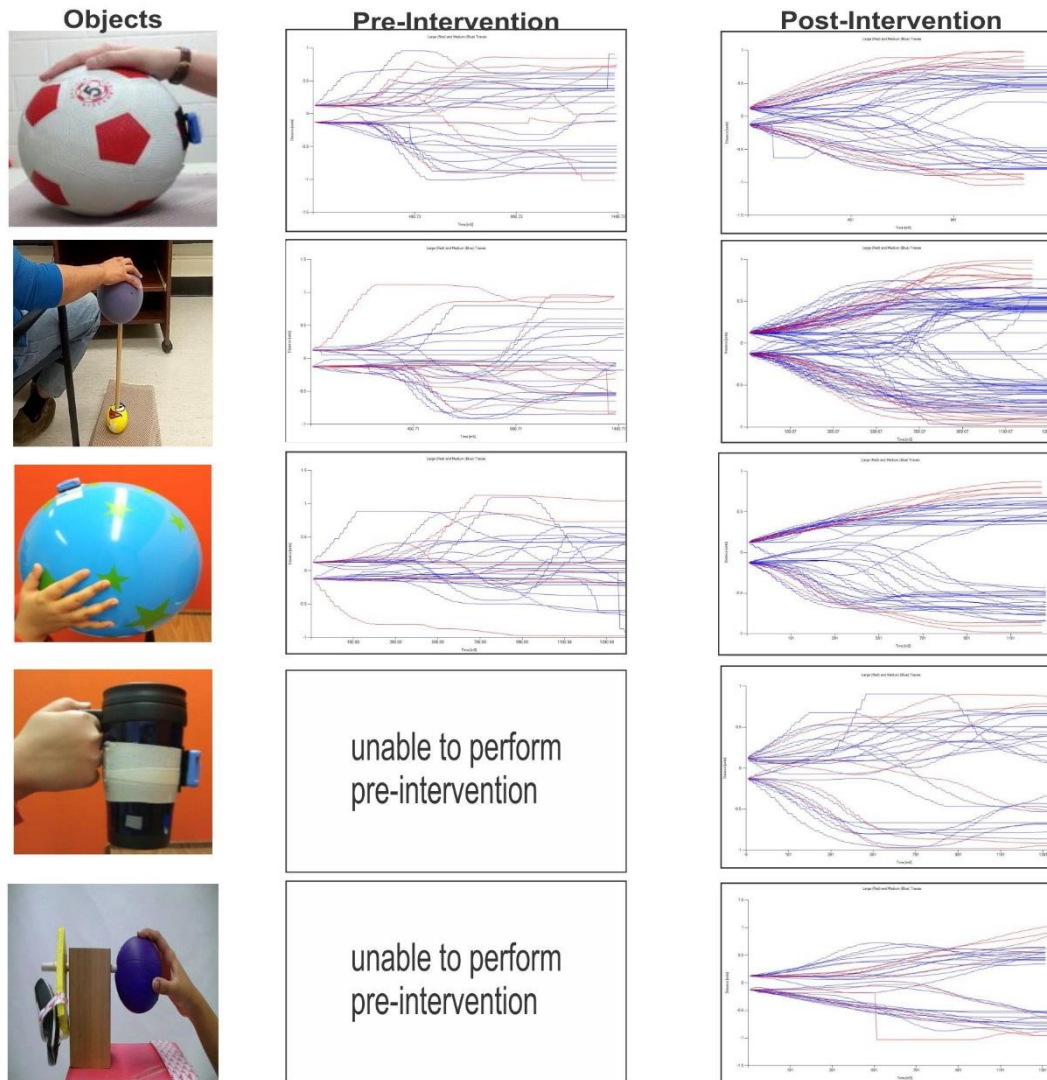
Outcomes

- Success rate
- Response time
- Movement time
- Movement accuracy
- Movement variation

Example Records of Object manipulation tasks of healthy control (context and stroke client)



Pre- to Post-intervention results of motor skills for various standardized object manipulation tasks



CONCLUSION

Although some difficulties with the technology were reported, the findings demonstrate feasible trial procedures and acceptable task-oriented training delivered at home with a relatively high compliance rate and positive outcomes.

These findings and the theoretical evidence direct the next phase of a full-scale randomized controlled trial (RCT).

Thank you