

Integrating motor learning and virtual reality into practice: a knowledge translation challenge

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ABSTRACT

Virtual reality (VR) systems are promising treatment options in stroke rehabilitation because they can incorporate motor learning strategies (MLS) supporting task-oriented practice. A pre-post design was used to evaluate a knowledge translation (KT) strategy supporting therapists in acquiring proficiency with VR while integrating MLS. Following e-learning modules and experiential learning, outcome measures evaluated changes in VR knowledge, attitudes, behaviours and MLS use. Improvements in therapists' behavioural control, self-efficacy, and VR knowledge were observed, though therapists used few MLS, with no improvement over time. Future KT strategies should target proficiency in VR use prior to integration of a theoretical treatment approach.

1. INTRODUCTION

VR systems are promising treatment options for physical therapists (PTs) and occupational therapists (OTs) in stroke rehabilitation because they incorporate motor learning principles of task-oriented, challenging, and motivating practice. However, documented challenges to VR system integration include limited knowledge regarding development of motor learning-based VR treatment programs targeting functional real-life goals (Glegg et al, 2013). The role of the therapist in VR is imperative for program design, monitoring, adaptation, and evaluation (Levac and Galvin, 2013). Untrained therapists may deliver sub-optimal intervention as they are unprepared to use VR systems effectively. Training support is required if therapists are to become competent at integrating VR into rehabilitation programs that transfer gains made in VR-based therapy to better functioning in the real world.

Training methods for clinicians should utilize evidence-based knowledge translation (KT) strategies to overcome the barriers inherent in adoption of these interventions (Grimshaw et al, 2012; Glegg, 2012). The purpose of this study was to develop and to evaluate the feasibility and effectiveness of a multi-faceted KT strategy to train PTs and OTs in motor learning-based VR implementation for stroke rehabilitation. The study focused on GestureTek's Interactive Rehabilitation Exercise (IREX) and Gesture Xtreme (GX) systems (www.gesturetekhealth.com, GestureTek, Toronto, ON, Canada).

2. METHODS

2.1 Participants

PTs and OTs were recruited from the population of therapists working on the stroke rehabilitation units of Bruyere Continuing Care (Ottawa, ON) and the Hamilton Health Sciences Regional Rehabilitation Centre (Hamilton, ON). Both sites provide inpatient and outpatient rehabilitation services to patients who have recently sustained a stroke. Therapists recruited patients into the study who were 0-12 months post-stroke onset and were receiving inpatient or outpatient PT and/or OT services focused on improving motor skills.

2.2 Procedures

This study utilized a pre-post design to evaluate a KT strategy. The KT strategy included the following components: *Interactive e-learning modules*: Three e-learning modules provided foundational knowledge about evidence for VR use in neurorehabilitation, neuroplasticity, motor learning principles, how VR systems can take advantage of motor learning principles, IREX/GX operation and game characteristics, and implementing motor learning strategies (such as variable practice, random practice, and promoting client problem-solving) into VR-based therapy. The format included pre- and post-module confidence logs as well as a variety of interactive activities and knowledge checks requiring learners to integrate and demonstrate their knowledge. Modules featured video clips illustrating game play as well as the implementation of MLS during VR use. *Experiential learning*: Experiential learning with the GestureTek system occurred in group and individual formats. Topics included system operation and trouble-shooting, a focus on clinical decision-making regarding selected games, and discussion about video clips of clients and therapists engaging with the VR system. Each therapist then recruited four patients and implemented 4 sessions of VR-based therapy per patient; 1 session for every second patient was videotaped for data analysis. *Audit and feedback*: Audit and feedback was provided to participants through individual practice sessions.

2.3 Outcomes

Therapist questionnaires and focus groups evaluated feasibility and effectiveness of the KT strategy. Changes in participant skill and knowledge were evaluated pre and post-study using the Assessing Determinants of Prospective Take-up of Virtual Reality (ADOPT-VR) instrument, which examines therapists' self-reported attitudes toward, as well as behavioural intention to use VR (Glegg et al, 2013). Face and content validity and responsiveness of this tool have been established (Glegg, 2012; Glegg et al, 2013). Video-Stimulated Recall (VSR), in which pre-determined motor learning competencies are scored during a semi-structured interview, and the Motor Learning Strategy Rating Instrument (MLSRI), which evaluates how therapists implement motor learning strategies during treatment sessions (Levac et al, 2013), were administered at 2 time-points (after treating 2 clients and after treating 4 clients), in order to evaluate progression in MLS skill with increased experience. The Software Usability Scale (SUS) (Brooke, 1996), which has demonstrated reliability, sensitivity and concurrent validity (Sauro and Lewis, 2012), evaluated therapists' post-use perspectives of VR usability.

2.4 Analysis

Based on non-normal distributions, non-parametric Wilcoxon signed rank tests evaluated change between pre- and post-study (ADOPT-VR) and first and second outcome assessments (MLSRI and VSR). Qualitative content analysis of focus group transcriptions was undertaken to identify benefits, challenges and common issues raised by therapists. Site 1 data was used alone in instances where site 2 data collection is ongoing.

3. RESULTS AND DISCUSSION

3.1 Therapist and client demographics

Four PTs and 2 OTs with an average of 19.3 years (SD 8.1 years) clinical experience but without previous GestureTek VR experience participated in Ottawa, providing VR interventions to 24 client participants with stroke. Client participants averaged 62.8 years (SD 16.4 years) with an average of 123.8 days (SD 166.7, range 21-682 days) post stroke. Three PTs and 2 OTs in Hamilton with an average of 11.4 years (SD 9.4 years) clinical experience and without previous GestureTek VR experience who provided VR interventions to 15 client participants with stroke (mean age 60.1 years (SD 15.0 years) and averaging 131.4 days (SD 176.7, range 14-624 days) post-stroke.

3.2 ADOPT-VR, MLSRI, VSR and SUS

On the ADOPT-VR, significant pre-post improvements in therapists' perceived behavioural control ($p=0.003$),

self-efficacy ($p=0.005$) and facilitating conditions ($p =0.019$) were observed. These changes reflect self-awareness about increased knowledge, capacity and confidence in using the system with clients, as well as perceptions of access to resources and supports necessary for VR integration, including time and technology support.

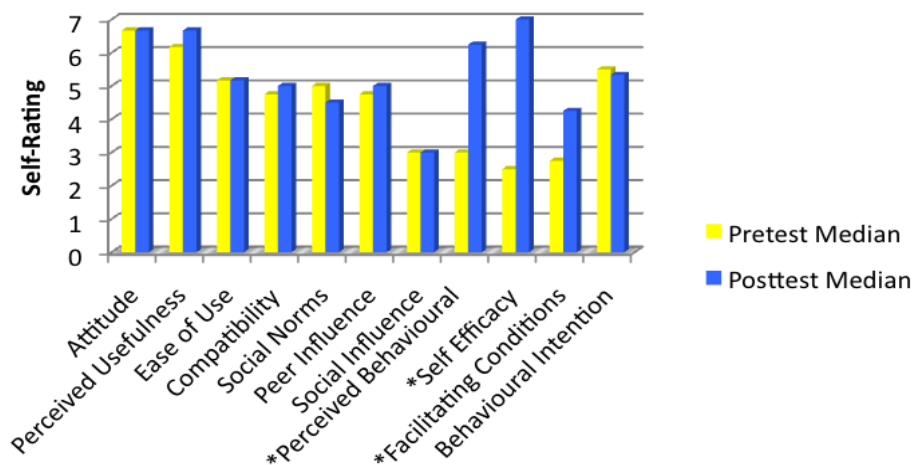


Figure 1. Pre/post ADOPT-VR median scores (both sites) *=statistically significant difference.

Using ICC, inter-rater reliability of the MLSRI was evaluated to be 0.80. Mean overall scores on the MLSRI at both time 1 (23.8%) and time 2 (15.8%) indicate a low observer-rated use of MLS; there was no significant change in MLSRI total ($p=.281$) or category scores (What Therapist Says: $p= .080$; What Therapist Does: $p=.713$; Practice: $p=.197$) at post-test (see Figure 2). These findings suggest therapists may have had difficulty integrating MLS into their clinical use of VR in this study timeframe.

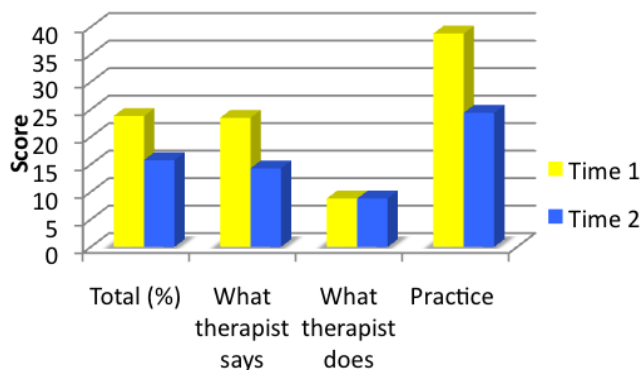


Figure 2. MLSRI category scores pre-post (site 1).

VSR total scores (74.4% at time 1 and 69.5% at time 2), indicate a good level of competency in therapist decision-making about VR use; no significant difference between time points was observed in total ($p=.889$) or item scores. These findings demonstrate early and effective integration of the VR knowledge gained, despite low perceived usability of the system, which was evidenced by an SUS mean score of 54.25 (19th percentile, below average).

3.3 Therapist perspectives

Therapists reported benefits to participating in the KT strategy, including application of the motor learning content to other areas of therapy provision. The multi-faceted methods addressed individual learning styles and were feasible within a busy clinical schedule. However, therapists were less positive about GestureTek use, reporting technical challenges with the VR equipment as well as environmental challenges with the rooms where the equipment was housed (e.g. location and size). The available games were not all perceived to be an ideal fit was difficult because available energy was expended on VR decision-making.

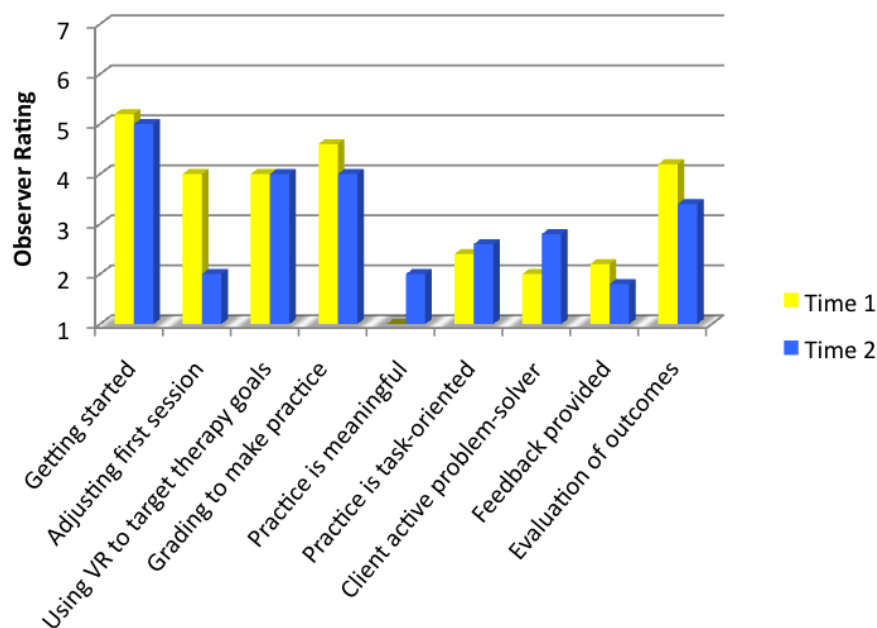


Figure 3. Video stimulated recall pre-post item scores (site 1).

4. CONCLUSIONS

VR integration into clinical practice can be challenging, as therapists require support to understand how to use the system to achieve therapeutic goals. A motor learning perspective is ideal given the ability of VR systems to target motor learning variables. This study was unique in evaluating the feasibility and effectiveness of a multi-faceted KT strategy that focused on both VR application and the integration of evidence-based MLS. Therapists reported benefits to the exposure to MLS knowledge beyond VR applications and were able to articulate accurate decision-making regarding VR use as measured by video-stimulated recall. Larger-scale studies using more homogenous client samples will improve confidence in the results.

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