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State of Evidence for Everyday Technology Use in Upper Extremity Motor Recovery Post-Stroke

Claire Ferree
University of Puget Sound

Dillon Oldham
University of Puget Sound

Amanda Robert
University of Puget Sound

Alana Yee
University of Puget Sound

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This evidence project, submitted by Claire Ferree, Dillon Oldham, Amanda Robert, Alana Yee has been approved and accepted in partial fulfillment of the requirements for the degree of Master of Science in Occupational Therapy from the University of Puget Sound.

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Project Chairperson: Tatiana Kaminsky, PhD, OTR/L

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OT635/636 Instructor: George Tomlin, PhD, OTR/L, FAOTA

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Acting Director, Occupational Therapy Program: Anne B. James, PhD, OTR/L, FAOTA

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Dean of Graduate Studies: Sunil Kukreja, PhD

Key words: everyday technology, upper extremity motor control, rehabilitation, stroke

Abstract

The research team, in consultation with collaborating clinician Sarah Bicker, an OTR/L at Harborview Medical Center, researched everyday technology applications. The team conducted a systematic review considering what evidence exists about the effectiveness of commercially available everyday technology (ET) for improving upper extremity motor control and/or motivation to participate in therapy in clients post-stroke. The evidence was promising in support of the use of ET as indicated by improved upper extremity motor control outcomes and client and clinician reports of satisfaction, motivation, and engagement in post-stroke rehabilitation. Clinicians should consider the benefits of implementing ET for upper extremity motor recovery for clients post-stroke.

Due to the changing nature of ET, the research team chose to minimize recommendations of specific applications. Instead, the team created a decision chart to help therapists identify what elements to consider when choosing a technology application to address the upper extremity motor control conditions/impairments with clients post-stroke. The decision tree considers performance skills according to the Occupational Therapy Practice Framework (OTPF), and includes current applications as examples. The research findings and decision chart were presented as an in-service to occupational therapy (OT) practitioners at Harborview Medical Center. Feedback from the in-service indicated that practitioners were positively receptive to the information provided and were more likely to incorporate ET into rehabilitation with their clients as a result of learning the research findings. Reviewing the literature indicates the need for more research regarding technology use for rehabilitation of individuals post-stroke.

Executive Summary

The purpose of this study was to determine the effectiveness of commercially available everyday technology (ET) for improving upper extremity (UE) motor control and/or motivation to participate in therapy in clients post-stroke. Research in technology can inform low-cost, commercially available treatment options and intervention effectiveness for improving functional abilities and support funding to be allocated specifically for technology in rehabilitation.

The research team, together with collaborating clinician Sarah Bicker, an OTR/L at Harborview Medical Center, conducted a systematic review to determine the literature available addressing the research question. Nineteen articles met the inclusion and exclusion criteria and were included in the study. The levels of evidence represented across the 19 articles were as follows: 5 Level I, 3 Level II, 5 Level III, 3 Level IV, 1 Level V and 2 qualitative articles. With supervision from the project chair, the research team critically analyzed all articles that met the pre-determined inclusion and exclusion criteria. There is promising evidence for the use of ET in increasing client engagement in therapy sessions, decreasing boredom in and out of therapy, and support of the effectiveness of mobile-based ET on improving upper extremity motor function in individuals post-stroke. Common outcome measures included, but were not limited to: The Box and Block Test, Fugl-Meyer, 9-hole peg test, and Wolf Motor Function Test. Clinicians should consider the benefits of implementing ET for upper extremity motor recovery with clients post-stroke.

The current research indicates promising outcomes for the use of ET in improving UE motor function post-stroke. Therefore, clinicians should consider the feasibility of incorporating technology-based interventions into practice settings. Studies show that clients are more engaged in therapy when ET is incorporated. Clients reported feeling satisfaction with increased social participation, leisure, and sense of independence through the use of ET, in conjunction with

decreased boredom levels and increased motivation in and out of therapy. Practitioners responded positively to using ET as a medium of treatment to improve UE motor function in rehabilitation. Considering the current evidence, the use of ET may be indicated for use in a variety of settings for the UE motor rehabilitation of individuals post-stroke.

Due to the changing nature of ET, the research team chose to minimize recommendations of specific applications. Instead, the team created a decision chart to help therapists identify what elements to consider when choosing a technology application to address the upper extremity motor control conditions/impairments with clients post-stroke. It includes current applications as examples while considering performance patterns according to the OTPF. The research findings and decision chart were presented as an in-service to OT practitioners at Harborview Medical Center. Feedback at the in-service indicated that practitioners were positively receptive to the information provided and were more likely to incorporate ET into rehabilitation with their clients after learning the information that was shared by the student researchers.

CRITICALLY APPRAISED TOPIC (CAT) PAPER

Focused Question:

What evidence exists about the effectiveness of commercially available everyday technology (ET) for improving upper extremity motor control and/or motivation to participate in therapy in clients post-stroke?

Collaborating Occupational Therapy Practitioner:

Sarah Bicker, MOT, OTR/L

Prepared By:

Claire Ferree, OTS; Dillon Oldham, OTS; Amanda Robert, OTS; Alana Yee, OTS

Chair:

Tatiana Kaminsky, PhD, OTR/L

Course Mentor:

George Tomlin, PhD, OTR/L, FAOTA

Date Review Completed:

01/22/2018

Clinical Scenario:

Our collaborating practitioner is an occupational therapist on the acute care unit at Harborview Medical Center seeing clients in critical condition. Our practitioner would like to know more about technology that can be used with stroke clients in acute care settings targeted at improving upper extremity motor control. Our practitioner is on the Assistive Technology (AT) committee at Harborview and would like to use the information collected in the CAT to inform the administration and fellow practitioners of possible effective, low cost ET that can be incorporated into rehabilitation services provided to clients. Due to limited direct funding in the University of Washington medical system for acute care, availability of technology resources does not allow therapists to readily try mobile technology applications or programs with clients. This necessitates looking into widely available technology that is more affordable for both therapists and clients. Technology research in acute care settings can inform treatment options and intervention effectiveness for improving functional abilities. If evidence is found supporting technology use in rehabilitation for clients post-stroke in increasing upper extremity motor control, funding may be allocated specifically to technology for rehabilitation.

Review Process

Procedures for the selection and appraisal of articles

Inclusion Criteria:

- Published in or translated to English
- Everyday technology: off the shelf, commercially available
- Outcomes focusing on upper extremity motor control and/or motivation

Exclusion Criteria:

- Robotics, robots
- Augmented communication
- VR with additional equipment/mounts/attachments
- Gaming devices/gaming systems that are not commercially available

Search Strategy

Categories	Key Search Terms
Patient/Client Population	• *stroke* • *post-stroke* • *cerebrovascular accident (CVA)* • *acquired brain injury (ABI)*
Intervention (Assessment)	• *everyday technology (ET)* • *commercially available technology* • *iPad, tablet, smartphone, iPhone*
Comparison	• *no comparison*
Outcomes	• *upper extremity motor control* • *motivation*

Databases and Sites Searched
PubMed, CINAHL, OT Seeker, Google Scholar, PEDRO, IEEE Xplore Digital Library, ProQuest Central
Journal of Disability and Rehabilitation: Assistive Technology, Journal of Neurorehabilitation, Scandinavian Journal of Occupational Therapy

Quality Control/Review Process:

Searching began using general search terms generated by the students and collaborating clinician including stroke, assistive technology, rehabilitation, acute care, app-based mobile device, tablet, and iPad, as well as relevant synonyms or alternate descriptions. It was difficult to sift through article abstracts without well-defined inclusion and exclusion criteria. Our original question was "Effectiveness of low-cost assistive technology (AT) for clients post-stroke in an acute care setting in improving functional outcomes." With guidance from the University of Puget Sound librarian, Eli Gandour-Rood, we searched in targeted journals and databases including IEEE Xplore, PubMed, ProQuest Central, and *Journal of Disability and Rehabilitation: Assistive Technology*. Reference and citation tracking were also used with relevant articles and resulted in the retention of more articles. A proposal of our CAT topic was reviewed by our faculty mentor, George Tomlin, PhD, OTR/L, FAOTA, our committee chair, Tatiana Kaminsky, PhD, OTR/L, and student peers to help us refine our question and search strategy.

Upon meeting with our faculty chair, Tatiana Kaminsky, it was made apparent the question we had was too broad and would not yield useful results. Tatiana introduced the term "everyday technology" as a new search criterion. With approval from our collaborating clinician, we targeted our search specifically for upper extremity motor control in clients post-stroke. Students screened previously retained article abstracts and kept them if upper extremity motor control was an outcome. Students continued conducting searches using defined key terms as well as inclusion and exclusion criteria, and reference and citation tracking were continued.

Upon further searching, we decided to include interventions using virtual reality if they included commercially available gaming systems/platforms including but not limited to PlayStation and Kinect. It is possible that these gaming systems/platforms can be acquired by the acute care unit for all therapists to have access to with clients. Due to assistive technology for stroke rehabilitation being a relatively new/recent intervention, there are limited studies and findings regarding the topic. Many studies are

"findings pending", preliminary studies/findings, study descriptions, and study justification articles. Therefore, to address the question of evidence for the effectiveness of commercially available ET for improving upper extremity motor control in clients post-stroke, some articles included in this review are preliminary findings, study descriptions and protocols.
Upon completion of database searching, citation and reference tracking, there were 43 articles that met the search criteria based on titles and abstracts. Upon full review of article texts, 24 articles not meeting the inclusion and exclusion criteria were excluded from the review.
The final articles in the CAT tables are organized alphabetically by evidence level (I-V) and by Qualitative, Quantitative, and Meta-analysis/systematic reviews.

Results of Search

Table 1. Search Strategy of databases.

Search Terms	Date	Database	Initial Hits	Articles Excluded	Total Selected for Review
Ipad AND post-stroke. Filters: peer-reviewed, Subject: stroke	9/7/17	Primo	28	28	0
Hospital AND CVA OR "cerebral vascular accident" OR "stroke" AND "assistive technology" OR "adaptive technology" AND acute AND rehabilitation	9/20/17	PubMed	6	6 (1 repeat)	0
Stroke OR "CVA" OR "cerebral vascular accident" AND ipad AND "AT" OR "assistive technology" NOT robotics AND intervention OR treatment AND hospital AND acute OR inpatient	9/20/17	PubMed	20	20 (1 repeat)	0
Assistive technology AND stroke rehabilitation	9/20/17	OT seeker	1	1	0
Assistive technology AND stroke	9/20/17	OT seeker	2	2 (1 repeat)	0
hospital AND CVA OR "cerebral vascular accident" OR "stroke" AND "assistive technology" OR "adaptive technology AND acute AND rehabilitation	9/20/17	PubMed	6	5	1
"stroke" OR "CVA" AND acute hospital OR inpatient AND rehabilitation AND "assistive	9/20/17	PubMed	10	10	0

technology" OR "adaptive technology" OR "AT"					
stroke OR CVA OR "cerebrovascular accident" AND "assistive technology" OR "adaptive technology" AND treatment OR intervention OR therapy AND acute OR inpatient NOT robotics OR robot OR robot-assisted	9/21/17	Google Scholar	70	68	2
Stroke AND ipad	9/21/17	Disability and Rehabilitation: Assistive Technology Journal	192	190	2
Stroke AND ipad	9/21/17	CINAHL	5	4 (1 repeat)	1
stroke AND ipad AND rehabilitation AND "tablet technology" NOT communication	9/21/17	Google Scholar	25	23	2
commercial gaming devices AND stroke	9/21/17	PubMed	4	3	1
stroke OR cerebrovascular accident OR cva AND mobile technology OR mobile devices OR cell phones OR tablets OR mobile applications AND intervention OR treatment OR therapy OR "occupational therapy" NOT robotics NOT communication	10/5/17	CINHAL	67	66 (1 repeat)	1
Tablet AND rehab AND hospital AND technology NOT robotics AND stroke OR CVA	10/5/17	PubMed	7	7	0
Stroke AND ipad	10/5/17	IEEE Xplore	6	5	1
stroke OR cerebrovascular accident OR cva AND mobile technology OR app based mobile devices OR tablet OR ipad OR iphone OR smartphone NOT robotics NOT communication	10/5/17	CINHAL	107	107 (5 repeat)	0

acquired brain injury" AND recovery	10/5/17	IEEE Xplore	4	3	1
Stoke AND assistive technology NOT robotics OR virtual reality	10/5/17	IEEE Xplore	19	19 (3 repeat)	0
stoke AND "acute care" AND mobile application	10/6/17	Proquest central	20	19	1
"stoke rehabilitation" AND "acute care" AND mobile application	10/6/17	Proquest central	5	5 (1 repeat)	0
"stoke rehabilitation" AND "acute care" AND "mobile technology"	10/6/17	Proquest central	10	10	0
"neuro-rehabilitation AND "acute care" AND "tablet"	10/6/17	Proquest central	9	9	0
stroke AND "mobile application" AND "acute care"	10/6/17	Proquest central	16	16 (2 repeat)	0
stroke OR CVA AND motor rehabilitation AND "fine motor" OR "gross motor" AND "everyday technology OR ipad"	10/14/17	Google Scholar	36	35 (1 repeat)	1
"stroke rehabilitation" AND tablet OR "everyday technology" AND "fine motor" OR dexterity	10/14/17	Google Scholar	317	307 (7 repeat)	10
stroke AND "everyday technology" OR ipad AND "fine motor" OR "gross motor"	10/15/17	Disability and Rehabilitation: Assistive Technology Journal	31	31	0
"everyday technology"	10/16/17	PubMed	56	56 (1 repeat)	0
"everyday technology" AND stroke	10/17/17	Scandinavian Journal of OT	47	47 (repeat)	0
Apps AND stroke AND rehabilitation AND motor	10/17/17	PubMed	4	4 (repeat)	0
stroke rehabilitation" AND tablet OR "everyday technology" AND "fine	1/17/2018	Google Scholar	89	89 (5 repeat)	0

motor" OR dexterity between 2017-2018					
game-based stroke rehabilitation	1/17/2018	Primo	47	46	1
((((stroke OR "cerebrovascular accident")) AND (mobile technology OR ipad OR tablet OR smartphone)) NOT robot) NOT communication between 01/10/78-1/21/18	1/20/2018	PubMed	38	38	0
(((ipad OR tablet)) AND stroke) AND rehabilitation between 01/10/78-1/21/18	1/20/18	PubMed	5	5	1
stroke OR cerebrovascular accident OR cva AND mobile technology OR app based mobile devices OR tablet OR ipad OR iphone or smartphone NOT robotics NOT communication AND between 01/10/78-1/21/18	1/21/18	CINAHL	5	5	0
Total number of articles used in review from database searches = 24					

Table 2. Articles from citation tracking.

Article	**Date**	**Database**	**Initial Hits**	**Articles Excluded**	**Total Selected for Review**
White et al., 2014	10/5/17	Google Scholar	18	16	2
Rand et al., 2015	10/12/17	Google Scholar	14	12 (1 repeat)	2
Kizony et al., 2016	10/12/17	Google Scholar	7	7	0
Rinne et al., 2016	10/15/17	Google Scholar	4	4	0
Ferreira et al., 2014	10/15/17	Google scholar	8	8	0
Hocine et al., 2015	10/15/17	Google scholar	15	15	0
Palacios-Navarro et al., 2014	10/15/17	Google scholar	3	3	0
Carabeo et al., 2014	10/15/17	Google Scholar	14	14 (6 repeat)	0
Total number of articles used in review from citation tracking = 4					

Table 3. Articles from reference tracking.

Article	Date	Articles Referenced	Articles Excluded	Total Selected for Review
Lindqvist et al., 2015	9/21/17	33	32	1
White et al., 2014	9/21/17	29	27	2
Ameer & Ali, 2017	10/5/17	59	54 (13 repeat)	5
Hung et al., 2016	10/5/17	45	42	3
Hocine et al., 2015	10/15/17	43	42 (3 repeat)	1
Ferreira et al., 2014	10/15/17	7	7	0
Palacios-Navarro et al., 2014	10/15/17	29	28 (2 repeat)	1
Pugliese et al., 2017	10/15/17	18	18 (3 repeat)	0
Suchak et al., 2016	11/2/17	26	24	2
Total number of articles used in review from reference tracking = 15				

Total number of articles used in review from database searches = 24
Total number of articles used in review from citation tracking = 4
Total number of articles used in review from reference tracking = 15
Total number of articles used in review from UPS Master's Thesis = 0
Total number of articles used in CAT following finalized inclusion and exclusion criteria = 19

Summary of Study Designs of Articles Selected for the CAT Table

Pyramid Side	**Study Design/Methodology of Selected Articles**	**Number of Articles Selected**
Experimental	_0_Meta-Analyses of Experimental Trials _3_Individual Randomized Controlled Trials _0_Controlled Clinical Trials _0_Single Subject Studies	3
Outcome	_0_Meta-Analyses of Related Outcome Studies _0_Individual Quasi-Experimental Studies _1_Case-Control Studies _4_One Group Pre-Post Studies	5
Qualitative	_0_Meta-Syntheses of Related Qualitative Studies _1_Small Group Qualitative Studies _0_brief vs prolonged engagement with participants _1_triangulation of data (multiple sources) _0_interpretation (peer & member-checking) _0_a posteriori (exploratory) vs a priori (confirmatory) interpretive scheme _0_Qualitative Study on a Single Person	2
Descriptive	_2__Systematic Reviews of Related Descriptive Studies _2_Association, Correlational Studies _4_Multiple Case Studies (Series), Normative Studies _1_Individual Case Studies	9
Comments: Qualitative do not have a place on the AOTA Levels of Evidence and are not reported below. AOTA Levels I- 5 II- 3 III- 5 IV- 3 V- 1		TOTAL = 19

Tables Summarizing *QUANTITATIVE* Articles

Author, Year, Journal Abbreviation, Country	Study Objectives	Study Design, Level of Evidence, PEDro score	Participants: Sample Size, Description, Inclusion and Exclusion Criteria	Interventions & Outcome Measures	Summary of Results	Study Limitations
Saposnik et al. 2010 *Stroke* Canada	Effectiveness, feasibility and safety of using Wii-based VR for motor recovery. Tech: Wii	Single-blind RCT pilot study I E2 Pedro: 7/10	*N* = 20 (41-83 yo) IC: 18-85 yo, first-time stroke. UE function >3 in Chedoke-McMaster scale. EC: unable to follow instruction, pre- stroke modified Rankin score ≥ *2,* medically unstable, uncontrolled hypertension, unstable angina, recent MI, hx of seizure, participation in another clinical trial w/ drugs or PT, and any condition putting person at risk.	Ix: Both groups received standard rehab along w/ 8, 1 hr sessions in 2 wks. EG played Wii games chosen for motions elicited. They were instructed to stop if they felt unwell. Ctrl took part in recreational activities using similar motions. O: WMFT, grip strength, BBT, Stroke Impact Scale. Time spent receiving Wii Ix, proportion experiencing adverse event from study.	EG: Sig improvements in WMFT (decrease of 10.5s), grip strength (increase of 6.4 kg). Both: Sig improvements in BBT (EG=8.6 blocks more, Ctrl =12 blocks more). EG (19.8s) performed sig better on WMFT than ctrl (27.4s). No sig safety concerns were found.	Pilot study with small sample, not powered to detect differences. Possibility that patients were more motivated to use "new tech" EG sig younger. EG was able to use compensatory motions to perform the games, which may not be functional motions to reinforce. Said results were statistically sig, but did not report *p* values.

Author, Year, Journal Abbreviation, Country	**Study Objectives**	**Study Design, Level of Evidence, PEDro score**	**Participants: Sample Size, Description, Inclusion and Exclusion Criteria**	**Interventions & Outcome Measures**	**Summary of Results**	**Study Limitations**
Yavuzer et al. 2008 *EJPRM* Turkey	Effects of PlayStation EyeToy games on motor recovery and UE-motor function in subacute stroke patients Tech: PlayStation	Single Blind RCT I E2 Pedro: 7/10	*N* = 20 EG: (*n* =10) Ctrl: (*n* =10) IC: unilateral stroke past 12 mo, Brunnstrom stage of I—IV, follow verbal directions, MMSE >16. EC: not specified	Ix: both groups received conventional rehab 2-5 hrs/day, 5 days/wk, for 4 wks. EG received additional 30 min of therapy playing “PlayStation EyeToy games”. Ctrl group watched the same games for 30 min but did not actively participate. O: Brunnstrom stages, FIM. Post tx and 3 mo follow up.	EG improvements were sig greater than ctrl immediately post tx in Brunnstrom hand ($p < .01$), Brunnstrom UE ($p < .05$) and FIM ($p < .05$). At follow up EG was only sig greater in FIM ($p < 0.05$). EG Brunnstrom scores increased rapidly from baseline to post tx and then plateaued to follow-up. Ctrl Brunnstrom scores steadily increased to match EG at follow-up	Amount of therapy received was variable between participants. FIM does not look specifically at improvements in hand function, instead looking at if a task can be completed. This allows for compensation or nonuse of the UE. Did not give statistical analysis of whether within group improvements were sig. Only looked at between group sig.

Author, Year, Journal Abbreviation, Country	**Study Objectives**	**Study Design, Level of Evidence, PEDro score**	**Participants: Sample Size, Description, Inclusion and Exclusion Criteria**	**Interventions & Outcome Measures**	**Summary of Results**	**Study Limitations**
Yoon-Hee et al. 2016 *Restorative Neurology and Neuroscience Journal* South Korea	Feasibility and effectiveness of mobile game-based UE virtual reality program for patients post-stroke Tech: Smartphone, Tablet	Double blind RCT I E2 9/10	*N* = 24 Setting: inpatient EG: *n* = 12 Mean age: 61 Ctrl: *n* = 12 Mean age: 72 IC: ischemic stroke, ability to follow one-step commands, clinical stability, UE impairment from Brunnstrom 1-5 EC: presence of delirium, confusion or other severe consciousness problems, uncontrolled medical conditions, unable to follow commands, visual deficits, poor sitting balance	Ix: both groups received 10 sessions of daily conventional occupational therapy 5x/wk for 2 weeks EG: 30 min conventional occupational therapy plus 30 min mobile upper extremity rehabilitation program (MoU-Rehab) Ctrl: 1 hr conventional occupational therapy/day O: MMT, FMA-UE, modified Barthel Index (MBI), EuroQol-5 Dimension (EQ-5D), BDI, user satisfaction survey	Both groups showed significant improvement in FMA-UE, Brunnstrom stage MMT, MBI, EQ-5D and both reduced scores on the BDI. EG significantly improved in FMA-UE, Brunnstrom stage, and MMT over ctrl at 1-month follow-up User Satisfaction survey (0-5 point Likert scale) showed both the ctrl and EG responded positively on all items, with the EG mean score above 4 on all items. Specific scores for ctrl group not specified.	Small sample size Longer follow-up needed to see if results are stable.

Author, Year, Journal Abbreviation, Country	**Study Objectives**	**Study Design, Level of Evidence, PEDro score**	**Participants: Sample Size, Description, Inclusion and Exclusion Criteria**	**Interventions & Outcome Measures**	**Summary of Results**	**Study Limitations**
Bao et al. 2013 *Neural Regeneration Research* China	Effectiveness of Kinect-based VR on recovery of upper limb function in stroke patients Tech: Xbox 360	Two groups, pre-post II O2 Pedro: 6/10	*N* = 23 (age 40-80 yo) Group 1 (*n* = 5, 4 males) stroke patients IC: stroke <3 mo cortex/subcortical infarction, wrist and MCP (A)ROM >10° EC: CHF, DVT, progressive HTN, liver disease, respiratory failure other CNS injury, UL fracture, mental illness, cognitive impairment Group 2 (*n* = 18, 8 males) healthy adults IC: normal UL function EC: dysfunction of UL, NS disease	Ix: 1-hr (4x10 min w/ 5 min rest) Kinect playing Fruit Ninja game 5day/wk, 3 wks O: FMA, WMFT	Within group change indicate significant decreases WMFT time *(p < .05)*, significant increases FMA score, ($p < .05$) for all stroke patients as well as healthy adults. Indicating improved UE motor recovery for patients post-stroke using Kinect-based VR.	Ctrl made up of healthy adults, not people with CVA. Impacts ability to compare groups. Group 1 (healthy adults) > Group 2 (stroke patients) in size, significantly more males in group 1.

Author, Year, Journal Abbreviation, Country	**Study Objectives**	**Study Design, Level of Evidence, PEDro score**	**Participants: Sample Size, Description, Inclusion and Exclusion Criteria**	**Interventions & Outcome Measures**	**Summary of Results**	**Study Limitations**
King 1993 *AJOT* USA	Feasibility: Association between hand strengthening exercises & purposeful activity Tech: Computer	Two group, counterbalanced order, no control II D2 Pedro: 3/3	*N* = 146 16-78 yo IC: bilateral grip & pinch ability EC: not reported Group 1(*n* = 80): grip strengtheners Group 2 (*n* = 66): pinch strengtheners	Ix: Purposeful activity = 3 min interactive game using gripper/pincher as controller. Non-purposeful activity = 3 min squeezing either gripper/pincher at comfortable pace O: frequency (repetitions)	Purposeful activity higher # repetitions w/ gripper (M = 237.2, $p < 0.001$) and pincher (M = 240.5, $p < 0.05$) v. non-purposeful activity (M = 170.7, 203.2)	R and L hand repetitions were summed Generalizability to occupational performance was not tested Client activity preference not considered for purposeful activity
Rand et al. 2013 *IEEE* Israel	Suitability of iPad for improving hand function post-stroke; Comparison between the performance of individuals w/ stroke and individuals w/o disability on existing iPad apps. Tech: iPad	Existing groups comparison II O3 Pedro: 4/6	*N* = 22 (11 male) IC EG: subacute or chronic stroke, able to grasp small objects, full hand function pre-CVA IC Ctrl: full hand function, I living, no disability EC EG: other neurological conditions, sensory deficit fingers	Ix EG: apps on iPad (*Peg Light 2, Dexteria-Tap It, Fast Tap, Bowling).* Ctrl Ix not described O: NHPT, FMA, BBT, Grip Strength	Ctrl performed significantly better than EG in all apps EG significant correlation between app performance and higher NHPT, BBT scores ($p <$ .05)	Preliminary findings for potential use of iPad in post-stroke hand rehab

Author, Year, Journal Abbreviation, Country	**Study Objectives**	**Study Design, Level of Evidence, PEDro score**	**Participants: Sample Size, Description, Inclusion and Exclusion Criteria**	**Interventions & Outcome Measures**	**Summary of Results**	**Study Limitations**
Carabeo et al. 2014 *Simulation and Gaming Journal* Philippines	Effect of tablet-based game on finger dexterity Tech: Tablet	One group pre-test post-test III O4 Pedro: 2/3	*N* = 3 Participants: 47-64 yo, 23-67 months post-stroke IC: wrist extension & finger extension at least 10 degrees of AROM, functional hearing & vision, undergoing standard rehab program EC: severe pain in affected arm	Ix: 30 min session 1-3x/wk for 1.5 months. App includes dragging, tapping, and stretching tasks. O: Rosenbusch Test for speed & accuracy	Speed of dragging task improved (up to 45% faster), accuracy of tapping increased (up to 37%), and speed of stretching improved (up to 63%). Response to intervention: participants reported tasks were difficult due to hand numbness, but suggested making game more challenging, preferred game with or instead of standard therapy.	Pilot study: small *N*, intervention inconsistent for each participant. No indication if results are statistically significant. No baseline measures taken with Rosenbusch Test

Author, Year, Journal Abbreviation, Country	**Study Objectives**	**Study Design, Level of Evidence, PEDro score**	**Participants: Sample Size, Description, Inclusion and Exclusion Criteria**	**Interventions & Outcome Measures**	**Summary of Results**	**Study Limitations**
Joo et al. 2010 *JRM* Singapore	Assess feasibility of using off the shelf gaming system (Wii) as "an adjunct to conventional rehab in patients with UE weakness as well as exploring if engagement improves perceived outcomes of UE strength." Tech: Wii	Single group, pre-post-test III O4 Pedro: 3/6	*N = 16* Mean age 64.5 IC: less then 3 months post-stroke. Medical Research Council motor power of at least 2, able to understand instructions & learn. EC: hx of epilepsy, arthritis or pain in affected UE restricting exercise, severe aphasia, cognitive impairment or psychiatric illness.	Ix: 6, 30 min sessions in 2 wks. Played games in Wii sports software depending on individual choice. Also received 1 hour PT and OT daily O: FMA-UE, Motricity Index, MAS. Questionnaire about Wii use.	Sig improvements in FMA-UE (*p* < .0007) and Motricity Index (*p* < .031). Wii use was seen as positive, complementary to therapy, and was recommended by 15/16 of participants	No control, all subjects received conventional rehab, and no follow up make hard to say if Wii made difference or if improvement was due to conventional therapy or spontaneous recovery.
Kizony et al. 2016 *JNPT* Israel	Feasibility, subjective experience, & tablet performance on motor function. Tech: Tablet	One group pre-test post-test III O4 Pedro: 2/3	*N* = 20 *M* age 59 w/ mild-moderate UE motor impairments IC: <1 wk post-stroke, actively open & close fingers, full function of hands pre-stroke, cognitively intact (>23 on MMSE) EC: other neurological conditions, acute orthopedic conditions of UE	Ix: 2 trials of "Tap It" and "Peg Light" apps in various settings (inpatient rehab & home). O: BBT, SFQ, speed, accuracy	15/20 stroke patients completed Tap It app game. 11 improved speed & accuracy from trial 1 to trial 2 (a 15% improvement). Also performed Peg Light task faster.	Convenience sampling used. Not all participants were able to use every app (5/20). Tx session time not indicated. Statistical significance not reported.

Author, Year, Journal Abbreviation, Country	**Study Objectives**	**Study Design, Level of Evidence, PEDro score**	**Participants: Sample Size, Description, Inclusion and Exclusion Criteria**	**Interventions & Outcome Measures**	**Summary of Results**	**Study Limitations**
Putrino et al. 2017 *Games for Health Journal* USA	Feasibility of new digital therapy gaming system and determine if enjoyment is correlated w/ better UE rehabilitation outcomes in chronic stroke patients Tech: Tablet	Pilot study; One group pre-test post-test III O4 Pedro: 5/6	*N* = 10 Chronic stroke pts IC: dx of one unilateral stroke, > 6 months post-stroke, >10 degrees active wrist extension & supination, MMSE: 24+ EC: jt contracture of affected wrist, hypertonicity (> 2 MAS), enrolled in another UE therapy	Ix: digital game "GesAircraft" Wrist flexion/extension, ulnar/radial deviation, forearm pronation/supination, controlling airplane through obstacles on screen 30 min sessions/6 wks LMC placed below wrist (ROM recorded and difficulty level adjusted) O: FMA-UE, ARAT, WMFT, SUS, PACES	FMA-UE: sig increase over 6 months ($p < 0.003$) ARAT: no sig diff WFMT: sig decrease in time to complete task ($p < 0.05$) SUS: "good" usability 72/100 +/- 7.9 (average = 68) Sig correlation after Tx between FMA-UE and PACES ($p < 0.005$) Initial level of impairment at baseline (FMA-UE) did not influence enjoyment (PACES) ($p = 0.21$)	Changes in FMA-UE scores did not reach MCID (5.25 pts) Small sample size Short duration of treatment session and intervention Number of repetitions not reported No control Participants had large range since onset (6 months to 13.5 yrs)

Author, Year, Journal Abbreviation, Country	**Study Objectives**	**Study Design, Level of Evidence, PEDro score**	**Participants: Sample Size, Description, Inclusion and Exclusion Criteria**	**Interventions & Outcome Measures**	**Summary of Results**	**Study Limitations**
Rinne et al. 2016 *PLoS ONE* UK	Comparing tablet or smartphone control functions of swipe, tap, joystick, and tilt to handgrip controller in UE movement of cursor on screen to determine ease of control. Tech: tablet & smartphone, handgrip controller	1 group, nonrandomized III D2 2/3	*N* = 87 IC: within 2 wks post-stroke pts at specialized stroke unit over 6 months EC: MMSE < 27, premorbid arm disability, impaired comprehension, sensorimotor neglect, arm pain, co-morbidities, no MRI confirmation of stroke Part 1: *n* = 42, comparison of four tablet/smartphone controls Part 2: *n* = 57 (12 additional participants from further cohort), comparison of novel vs conventional swipe control	Months 1-3: comparing 4 tablet/smartphone control methods (swipe, tap, joystick, tilt) to control cursor on screen 3 x/trial, 1 min trials Finger-swipe, tap, & joystick on tablet, tilt on smartphone Months 4-6: two-min game play, tablet/smartphone control method v. handgrip controller Ctrl: unaffected side O: FM-short, level of cursor control: 0 –3 and MME (minimum moving error)	No sig diff between 4 tablet/ smartphone controls in FM scores No sig diff between FM scores level of disability (min/mod/severe) and MME Poorer control w/ hemiplegic side v. unaffected arm for severe ($p < 0.001$) and mod ($p < 0.05$), but not mild Handgrip controller most control, especially for severe: 58% achieved level of control 3 v. 0% for swipe	May not generalize to functional activities Strict EC, eliminated 75% of recruited patients Cost of handgrip controller

Author, Year, Journal Abbreviation, Country	**Study Objectives**	**Study Design, Level of Evidence, PEDro score**	**Participants: Sample Size, Description, Inclusion and Exclusion Criteria**	**Interventions & Outcome Measures**	**Summary of Results**	**Study Limitations**
Hung et al. 2016 *Journal of Medicine* Taiwan	Opinions of stroke patients and occupational therapists in neuro-rehabilitation on game-based rehabilitation systems in therapy Tech: Tablet	Survey IV D3 Pedro: 2/3	*N* = 44 (*n* = 30): stroke patients IC: from one hospital recruited by occupational therapists EC: severe aphasia, visual impairment, psychiatric illness (*n* = 14) occupational therapists IC: occupational therapist works in neuro-rehab from two hospitals EC: not reported	Ix stroke patient: Rehab preference survey as 30-40 min interview Ix occupational therapist: trained to play 12 games: 3-min each game, then complete rehab-compatibility survey	Stroke patients and therapists reported issues w/ diversity & entertainment of games Stroke patients: like use of game-based rehab b/c novel & perceived as effective, but needs link to personal life & want more socially interactive games Therapists: reported user-driven games, simple interface, & familiarity may increase motivation	IC unclear, OT EC not reported Lacks description of survey results analysis
Lawson et al. 2017 *AJOT* USA	Effect of mobile app on motor control Tech: smartphone	Mixed methods, multiple case study IV D3 Pedro: 1/3	*N* = 6 (1 male), 5 participants 2 or fewer yrs post-stroke, 1 participant 15 yr post-stroke IC: own a smartphone, use independently, access to internet EC: none listed	Ix: 6 wks, 8 "ARMstrokes" app exercises O: ARAT, CAHAI, AM-PAC, MMT, Modified Ashworth scale. Not all subjects received same Ix or tested same O measures due to individual needs	Increases in ARAT (2-4 points), CAHAI (8 points), & PROM shoulder abduction (54 degrees)	Pilot study: small *N*, inconsistent intervention (participants used different apps depending on their baseline function), length of session not reported. Did not report statistical significance.

Author, Year, Journal Abbreviation, Country	**Study Objectives**	**Study Design, Level of Evidence, PEDro score**	**Participants: Sample Size, Description, Inclusion and Exclusion Criteria**	**Interventions & Outcome Measures**	**Summary of Results**	**Study Limitations**
Valdes et al. 2015 *IEEE* Canada	Gather data for bimanual gaming rehab system for guiding home-based rehab programs using motion-based game controllers; repetitive AROM practice using game Tech: PlayStation	Case series, 3 individuals I D3 Pedro: 2/3	*N* = 3 (2 post-stroke, 1 healthy adult) IC/EC not stated. Individual participant detailed descriptions included	Ix: 90-min training with gaming system, computer game with adapted PlayStation technology, repetitive AROM practice using game O: Gaming system gathered data on UE AROM, density plots for AROM, hand velocity and acceleration	AROM Ctrl > stroke patients. Stroke patients inconsistent amount of time spent at each "work station" in the game, velocity and acceleration indicate motor deficits. Stroke patient did not use compensatory stabilizing strategies.	Ix not explained, time using computer game unknown, any guidance from the therapist was not adequately described Feasibility Study
Ferreira et al. 2014 *IEEE* Germany	Proof-of-concept test; Description of smartphone games and their accuracy in measuring UE movement to inform future use of app games Tech: smartphone	Case report V D4 Pedro: n/a	*N* = 1 No information given IC/EC: not reported	Ix: proof of concept tests: "Grab and Rotate,"" Avoid Block," and "Balloon Strike" No Ctrl Engineering study, no outcome measures, they did report on satisfaction	Patient satisfied and motivated w/ games Application easy to use and adapted to goal Increases motivation to engage	No description or results of patient

Table Summarizing *Qualitative* Articles

Author, Year, Journal, Country	Study Objectives	Study Design/Level of Evidence	Participants: Sample Size, Inclusion & Exclusion Criteria	Methods For Enhancing Rigor	Themes & Results	Study Limitations
Celinder & Peoples, 2012 *Scandinavian Journal of OT* Denmark	Patients' experience using Wii sports as supplement to OT in hospital setting. Tech: Wii	Phenomenological Q3	*N* = 9 (51-95 yo) IC: mild to severe symptoms. Currently undergoing OT and will need OT at discharge, at least 18 yo, medically confirmed stroke EC: transient ischemic attacks, epilepsy, dizziness, or implanted medical devices.	Triangulation of data through field notes of patients' reactions and interviews. All interviews conducted by same investigator. Interviews were recorded and transcribed verbatim	Overarching theme: Connecting to past, present, or future occupations. Subthemes: Variety (breaking up day, new topic of conversation, desiring meaningful occupations), Engagement (excitement and motivation, gaining control and benefits, wishing to play again), being disappointed, physical/cognitive challenges	Small sample. Potential selection bias because of participant selection agreed upon by team Cognitive deficits can impact narratives.
Author, Year, Journal, Country	**Study Objectives**	**Study Design/Level of Evidence**	**Participants: Sample Size, Inclusion & Exclusion Criteria**	**Methods For Enhancing Rigor**	**Themes & Results**	**Study Limitations**
White et al. 2015 *Disability and Rehab* Australia	Clients' experience using an iPad in the first 3 months of stroke recovery Tech: iPad	Phenomenological Q3	*N* = 12 Setting: iPad training in rehab facility, iPad use in facility & home IC: minimum 2 stroke related impairments EC: minimal deficits (not further defined)	Thematic saturation (*N* > 10) Interview schedule & research questions administered by experienced stoke clinician; data immersion; reflexive analysis; memo writing; peer debriefing; team consensus coding	(1) Getting established on iPad: inc confidence (2) stimulation, clients felt empowered, clients perceived contributions to improved outcomes (3) Personal experiences of access to an iPad: access educational materials, inc independence, inc social activity, leisure	Frequency of iPad use varied, only 1 interview, no follow up (assess changes over time) Member checking was not reported

Table Summarizing *Meta-Analyses/Meta-Syntheses/Systematic Review* Articles

Author, Year, Journal Abbreviation, Country	**Study Objectives**	**Study Design, Levels of Evidence of Studies**	**Number of Papers Included, Inclusion and Exclusion Criteria**	**Interventions & Outcome Measures**	**Summary of Results**	**Study Limitations**
Ameer & Ali, 2017 *MDPI* UK	Analysis of feasibility and impact of iPad tech use w/ post-stroke impairments Hospital and community-based Tech: iPad	Literature review I D1	16 articles (4 specifically for stroke neuro-rehab) IC: English, Apple iPad tech studies only, stroke neuro-rehab trials only EC: non Apple technology	Hand performance/dexterity Mostly qualitative info	The studies that looked at home rehab w/ iPad use involving UE motor control found positive results.	Few studies address motor impairments (mostly speech) Apple product only
Hondori & Khademi 2014 *Journal of Medical Engineering* USA	Examine available literature on use of Microsoft Kinect in physical rehab post-stroke. Tech: Kinect	Literature Review I D1	22 articles (7 specifically for UE stroke rehab) IC: Kinect-based studies with clinical evaluations EC: Not specified	Ix: Interventions involving the use of Kinect. O: FM, WMFT, Joint angle error, clinical observations	In all studies individuals receiving rehab with the Kinect showed improvements in UE function.	Only searched PubMed & Google scholar. Did not explain how articles were reviewed and selected. Many studies were of limited *N* and did not include statistical analysis.

Key to Abbreviations

Abbreviation	Full Phrase
AM-PAC	Activity Measure- Post Acute Care
ARAT	Action Research Arm Test
AJOT	*American Journal of Occupational Therapy*
BDI	Beck Depression Inventory
BBT	The Box & Block Test
CAHAI	Chedoke Arm and Hand Activity Inventory
CHF	Congestive heart failure
Ctrl	Control group
EC	Exclusion Criteria
EG	Experimental Group
GFHJ	*Games for Health Journal*
EJPRM	*European Journal of Physical and Rehabilitation Medicine*
FM	Fugl-Meyer
FMA	Fugl-Meyer Motor Assessment
FMA-UE	Fugl-Meyer Assessment of Upper Extremity Function
IC	Inclusion Criteria
Inc	Increase
iJIM	*International Journal of Interactive Mobile Technologies*
Ix	Intervention
JHT	*Journal of Hand Therapy*
JNPT	*Journal of Neurologic Physical Therap*y
JRM	*Journal of Rehabilitation Medicine*
MCID	Minimal clinically important difference
MDPI	*Molecular Diversity Preservation International*
MME	Minimum Moving Error
MMSE	Mini Mental State Examination
MMT	Manual Muscle Testing
NHPT	9-Hole Peg Test
O	Outcomes
PACES	Physical Activity Enjoyment Scale
pt	Patient
RCT	Randomized Controlled Trial
ROM	Range of Motion
SFQ	Short Feedback Questionnaire
Sig	Significantly
SUS	System Usability Scale
Tech	Technology Used in Study
Tx	Treatment
UE	Upper Extremity
VR	Virtual reality
Wks	Weeks
WMFT	Wolf Motor Function Test
yrs	Years

Summary of Key Findings:

Summary of Experimental Studies

There is limited, but promising evidence from three experimental studies of the effectiveness of ET in improving UE motor control for individuals post-stroke. One study found use of Wii was safe and improved UE motor function. Another study used Brunnstrom stages and FIM scores to track changes in UE motor function, however, the extent of therapy varied among participants. Significant improvement was found for UE motor control as measured by FIM and Brunnstrom after treatment and significant improvements in FIM at follow up.

Summary of Outcome Studies

There is promising evidence from five outcome studies that mobile, app based ET was effective at improving UE motor control in individuals post-stroke. Outcome measures include Rosenbusch Test, BBT, SFQ, FMA, NHPT, grip strength, WMFT, Motricity Index, and MAS. The studies all showed improvements in UE motor performance for all specified outcomes used; however, the studies were small in size. Two studies did not contain statistical analyses around significance. There was limited evidence from outcome studies that therapy involving commercially available game systems is effective at improving UE function in individuals post-stroke. There were three studies with limited sample sizes, but that showed statistically significant improvements in measures of UE function.

Summary of Qualitative Studies

There is promising evidence from two studies for the use of ET in increasing client engagement in therapy sessions and decreasing boredom in and out of therapy. Staff in rehabilitation units responded positively to incorporating ET use into treatment. A promising study conducting interviews found clients using an iPad during rehab had increased confidence and stimulation, felt less of a loss regarding roles, and experienced increased empowerment. The clients reported use of the iPad for accessing educational materials, social activity and leisure contributed to a sense of increased independence.

Summary of Descriptive Studies

There is emerging evidence to support the effectiveness of mobile based ET on UE motor function in individuals post-stroke. One study found improvements in UE function as measured by strength and PROM, but had an inconsistent intervention protocol. The articles found in this review, while limited in number, all showed positive results for home based rehab with an iPad. Another study found clients were more engaged and motivated by an app, but did not include data on UE function. One literature review found improvements in UE function when using a gaming system during treatment.

Implications for Consumers:

Consumers for ET intervention are individuals post-stroke in acute care settings. Client populations in this research included individuals post-stroke in a variety of treatment settings along the continuum of care, but did not specifically include clients in acute care settings. A few articles included client perspectives and experiences regarding the use of ET in treatment and found increases in engagement, motivation and satisfaction. Consumers who are already active users of technology could advocate for instruction in how to use their technology in a therapeutic manner by the therapists. All clients could advocate for the option of including ET in their treatment sessions if feasible.

Implications for Practitioners:

There is a growing body of evidence supporting the effectiveness of using ET as treatment to improve UE motor function in individuals post-stroke. Due to the emergent nature of ET use in rehabilitation, clinicians hoping to use mobile applications and gaming systems in practice should maintain awareness of developing research. The current research indicates promising outcomes for the use of ET in improving UE motor function post-stroke; therefore, clinicians should consider the feasibility of incorporating technology-based interventions into acute care practice settings. Although research has not been done in acute care, many of the articles reviewed included individuals < 6 months post-stroke, and the results of these studies may be applicable to clients in acute care. Studies also show that clients are more engaged in therapy when ET is incorporated. Clients reported feeling satisfaction with increased social participation, leisure, and sense of independence through the use of ET as reported in conjunction with decreased boredom levels and increased motivation in and out of therapy. Practitioners responded positively to using ET as a medium of treatment to improve UE motor function in treatment sessions. Considering the current evidence, the use of ET may be indicated for use in a variety of settings, including acute care, for the UE motor rehabilitation of individuals post-stroke.

Implications for Researchers:

Reviewing the literature indicates the need for more research regarding technology use for rehabilitation of individuals post-stroke. Future RCT studies should be conducted addressing the effectiveness of ET in UE motor control stroke rehabilitation to increase rigor of the findings. More specifically, there is a need for evidence of the effectiveness of ET in an acute care setting with long term follow-up including functional outcome measures that clearly and directly relate to UE motor control. There needs to be specific mobile-based applications for UE motor control rehabilitation that will be maintained over time with changing technology and used across multiple platforms.

Bottom Line for Occupational Therapy Practice/ Recommendations for Better Practice:

Although only one study reviewed was done in acute care, there were many studies that included participants in the acute phases post-stroke, and these findings may be applicable to acute care stroke rehabilitation. The evidence, while limited, was promising in support of the use of ET as indicated by client and clinician reports of satisfaction, motivation, and engagement in post-stroke rehabilitation. Clinicians should consider the benefits of implementing ET for UE motor recovery with clients and be aware of future research and implications of technology use in their specific practice settings. Practicing therapists should continue to engage in data collection on the effectiveness of mobile-based applications use in therapy. Clinicians should maintain thorough records of the use of ET in rehabilitation to inform retrospective studies.

Involvement Plan

Introduction

On November 29, 2018, the research team met with collaborating clinician Sarah Bicker, OTR/L to present findings around the research question: "What evidence exists about the effectiveness of commercially available ET for improving UE motor control and/or motivation to participate in therapy in clients post-stroke?" Following explanation of the search strategy and results in the table, Ms. Bicker was presented a preliminary summary of the findings. An overview of the studies indicated emerging and positive findings for improving UE motor control and implications impacting motivation in therapy were described. Ms. Bicker was excited about the findings and anticipates that the information will be useful in supporting the need for the equipment and mounts. She hopes to implement the findings in her practice setting and thinks that this research will help link ET use to goals in acute care, such as increasing fine motor skills to complete dressing activities. Research supporting use of everyday technology in treatment may show isolated gains and proof to cite to third party payers of the need for using ET as an intervention. Ms. Bicker is also on the assistive technology committee at Harborview and hopes to use the information to build the committee's knowledge base and spread information to other therapists about using the latest evidence-based practice, specifically surrounding ET use.

Since ET and its applications available change constantly, it was decided that a simple manual or list of applications appropriate for use in UE stroke rehabilitation would quickly become outdated and no longer relevant to therapists. Instead, the research team created a decision chart to help therapists identify what elements they should look for in choosing an application to address the UE motor control conditions/impairments their post-stroke clients experience (see Appendix A and Appendix B). It included current applications as examples as a starting place (see Appendix C). The decision chart considers performance skills, client abilities in UE movements, as well as the complexity of the application itself. This allows the therapist to see suggested categories of applications to address these specific client needs (for example visual motor skills, dexterity, etc.) as well as appropriate gaming consoles or technology devices to be used with that client.

Following the creation of a decision chart, Ms. Bicker felt that the information would best be presented to OT practitioners at an in-service presentation. She also believed that more than just occupational therapists on the acute care unit would benefit from this information, considering that a majority of our studies were conducted in other settings. The research team provided an in-service presentation to the OT practitioners at Harborview to present the decision chart and summarize the main research findings applicable to the acute care setting. The in-service was 30 minutes during the communal lunch hour with time allotted for specific questions related to the decision chart, our research findings, and exploration of a few apps on iPads. (See Appendix D for in-service presentation and Appendix E for in-service flyer).

Context

Ms. Bicker was part of the AT committee at Harborview and stated that there was limited funding for this department. The donations made to the hospital are distributed in a specific way, and very little of that money reaches the acute care unit. The AT committee has its own funds, but the money is split among all the departments that are involved in the committee. Therefore, the OT department receives only a portion of those funds, making it difficult to purchase new technology. This creates a barrier in knowledge translation because of the limited ability to purchase and utilize new technology in the OT department.

The OT practitioners currently borrow an iPad from the speech language pathologists and have recently purchased an iPad for the OT department. A charging station with a location that is permanent, yet accessible to all practitioners in the hospital, is a possible barrier. Since there are currently only two iPads available for use, the OT practitioners would need to coordinate with each other on when to use the iPads and ensure that the iPads have time to charge before the next use. Creating a check-out and charging schedule that all the practitioners are aware of and can access would require time and coordination in the OT department.

Another limitation in the implementation of iPads during OT sessions is the therapist and client's ability to use the iPads. The therapist would have to understand how to navigate the iPad, use the features, and access the apps. They also would need to be familiar with how to play the apps, add new apps to the iPad, and ensure the apps are up to date and still work. In addition, the clients would need to have a general understanding of how to tap the screen to get an accurate click or swipe in order to play the games. Clients would also need to be receptive to using technology during interventions. Some of the therapists at Harborview indicated that they may need clear instructions on how to use new techniques incorporating ET into treatment sessions. The knowledge and familiarity of iPad use during clinic sessions by both the therapists and clients can impact knowledge translation. The therapists would have to be proactive in making sure the iPad and apps are up to date and working, as well as understanding how to troubleshoot any problems that arise.

Tasks/products

Task/Product	Deadline Date	Steps w/ Dates to Achieve Final Outcome
Decision Chart for Everyday Technology Use	February 20	Divide up between research team members to research decision chart factors
	March 1	Begin constructing decision chart
	March 20	Confirm final decision chart with project chair
	March 25	Confirm final decision chart with Ms. Bicker
	March 25	Finalized Decision Chart Complete
In-service for Practitioners	March 20	Begin to prepare in-service presentation
	March 29	Provide Ms. Bicker with a brief informational poster/ email about the in-service to give to practitioners
	1 week before presentation	Get approval for presentation from project chair
	April 11	Research team will present decision chart and summarize research findings at a 35-45 minute in-service to the OT practitioners at Harborview Medical Center. Schedule in-service as soon as possible for April.
Outcomes Monitoring Consultation/ Documenting KT by Practitioners	Follow up in May/end of April - after in-service presentation Determine strategy for practitioner outcome documentation by with Ms. Bicker - April 25	We had discussed possibly tracking the number of times practitioners use the decision chart over a certain period of time, or number of times the technology device/gaming consoles are checked out by practitioners. Research team will consult with Ms. Bicker at or after the in-service to determine documentation strategy for tracking technology use in therapy sessions with occupational therapists.

Monitoring Outcomes

Throughout the project, one team member was designated to be the deadline scheduler with the responsibility of keeping the team on track for completing tasks by the established deadlines. This ensured that the team completed the project on time and to the best of their abilities. Following the in-service, the team discussed the positive and negative aspects of the presentation with the project chair, and what the best methods were to ensure therapist understanding and implementation of information. This included providing continued resources, a summary document about the in-service, etc to all occupational therapists at Harborview.

Upon completion of each step (decision chart and in-service preparation), the team consulted with the project chair to ensure that the final product was being monitored throughout the process. With approval from the chair, the task steps were presented to the collaborator to ensure the project was aligning with her ideas and what would work best for her rehabilitation setting.

Knowledge Translation

Due to the changing nature of ET, the research team created a final decision chart to help therapists identify what elements they should look for when choosing an application to address the UE motor control conditions/impairments their post-stroke clients experience. It included current applications as examples while considering performance skills according to the OTPF. The research team focused on terms that would be most relevant to the OT practitioners working in a hospital setting. The research findings and decision chart were presented at an in-service for the OT practitioners at Harborview Medical Center.

Originally, the research team was interested in creating a decision tree based on performance goals or performance deficits and provide yes or no questions to work towards an end technology use recommendation. During the project process, the research team found that the decision tree was not the best method to present the findings nor would it be a helpful resource for working clinicians regarding technology use. There is no single application or gaming device to recommend to each client, rather there are many options that may address different client factors appropriate for each client. The decision tree was very limiting in the way it led the user to a type of technology with duplicated types of technology, which the research team felt would be confusing to clinicians.

With guidance from the project chair, a different design was drafted for a decision chart (Appendix A). The goal of the chart is to help clinicians decide what type of application or gaming device would be appropriate to use with a client based on specific performance skills that are impaired or client performance goals. The chart is split into tablets and gaming consoles and what performance skills defined by the OTPF would be supported through use of the type of technology. The research team found this to be much easier to understand visually and gave the user a place to start when using technology as rehabilitation, rather than telling the user what specific application or game to use. The decision chart also includes some considerations regarding technology use with clients, such as certain precautions and ways to modify the technology use to best fit the client's current abilities (Appendix B).

An in-service flyer was created to advertise the April 11th in-service at Harborview (Appendix E). An in-service survey was created that was given to OT practitioners at the conclusion of the presentation to gather information about their likeliness of technology use in treatment sessions and barriers they may encounter regarding implementation (Appendix F). The goal of the survey was to gather data regarding OT practitioners’ perceptions of ET use at Harborview before and after the presentation of the research findings.

On April 11th, 2018, the research team presented the research findings in a 30-minute in-service to 11 OT practitioners during their lunch hour. A PowerPoint presentation was given to orient them to the research found, the application of the research to their site, and provide an explanation of the decision chart (Appendix D). There was time for the OT practitioners to look over the decision chart, explore apps on the iPads available or on their personal smartphones, and ask questions. The survey was completed within the last five minutes of the in-service, and clinicians were able to take a copy of the decision chart with them. (Appendix F)

The survey results indicated that the OT practitioners were receptive to using ET as a part of treatment sessions, and the likelihood of use increased as a result of attending the in-service. The main barriers to ET implementation into treatment reported were the limited amount of treatment time available and the sharing of technology among the OT practitioners. Since there is only one iPad and Wii console currently available for the OT practitioners to use, along with the limited budget for the acute care unit, it would be difficult for the clinicians to coordinate the use of the technology with each other while increasing ET use in treatment. By the conclusion of the in-service, the OT practitioners demonstrated understanding of how to locate apps on the iPad or their smartphones and were able to explore some of the iPad app games suggested. At the end of the in-service, the OT practitioners provided positive feedback regarding using apps during treatment; 9/11 practitioners indicated that they were more likely to use ET after the presentation. The research team followed up with the collaborating clinician to discuss ways to decrease barriers identified for using ET in therapy. No further recommendations or feedback were provided at this time.

Schedule of Task Completion

Task/Product	**Deadline Date**	**Steps w/ Dates to Achieve Final Outcome**	**Completion Date**
Decision Chart for Everyday Technology Use	February 20	Divide up between research team members to research decision chart factors	February 20
	March 1	Begin constructing decision chart	February 27
	March 20	Confirm final decision chart with project chair	March 28
	March 25	Confirm final decision chart with Ms. Bicker	March 28
	March 25	Finalized Decision Chart Complete	March 29
In-service for Practitioners	March 20	Begin to prepare in-service presentation	March 5
	March 29	Provide Ms. Bicker with a brief informational poster/ email about the in-service to give to practitioners	March 28
	1 week before presentation	Get approval for presentation from project chair	April 6
	April 11	Present decision chart and summarize research findings at a 35-45 minute in-service to the OT practitioners at Harborview Medical Center.	April 11
Outcomes Monitoring Consultation/ Documenting KT by Practitioners	Follow up in May/end of April - after in-service presentation	Consult with Ms. Bicker at or after the in-service to determine documentation strategy for tracking technology use in therapy sessions with OTs. Provide Ms. Bicker with electronic copies of presentation, decision chart, and list of current applications for distribution.	April 16

Outcome Monitoring

Throughout the process of creating the knowledge translation project, consultation from our project chair was sought out. The project chair was crucial in guiding the research team to create a useful and effective resource for practicing clinicians.

To monitor the effectiveness of the in-service presentation, a survey was constructed and distributed to all attending OT practitioners at the in-service. The survey included questions regarding any change in the OT practitioners' likeliness of using ET and barriers they may face when using ET in rehabilitation after participating in the in-service. Due to the difficulties of tracking data on actual ET usage in rehabilitation after the research team has graduated, no further monitoring was planned. The collaborating clinician expressed interest in tracking outcomes in clients who are using ET in treatment sessions, but this has not become a formal plan.

Outcome Evaluation

To monitor the effectiveness of the in-service presentation, a survey was constructed and distributed to all attending OT practitioners (Appendix F). Eleven surveys were distributed and all were completed and returned. Feedback from the surveys indicate that the likelihood of using ET in treatment interventions increased for 73% of the attending therapists; 9% of the attending therapists were not likely to increase use of ET of treatment and 18% of the attending therapists were already very likely to use ET in treatment interventions. Results from the survey suggest that the in-service was effective in distributing information regarding ET use to working clinicians.

Survey results revealed current barriers to ET use in treatment interventions including limited treatment time (81%), sharing technology with other therapists (27%), being unfamiliar with technology (45%), inappropriate for clients (27%), clients without their own devices (27%), patient level of ability to engage (9%), and caseload specific (9%). These barriers were reviewed with the collaborating clinician in hopes of identifying ways the hospital could support the increased use of ET.

The decision chart, an extensive list of current apps categorized in accordance with the decision chart, and considerations regarding ET use in treatment were provided in paper form to the OT practitioners to take with them. These documents were positively received by the therapists attending the in-service, and the research team received many requests for additional paper copies as well as electronic copies of the forms provided. The research team ensured that the collaborating clinician had electronic copies of the in-service presentation, decision chart, and list of applications to distribute to all OT practitioners at Harborview.

Recommendations

Based on the research process of knowledge translation and implementation, it is recommended that further literature reviews be conducted in similar areas regarding ET use in treatment.

During the literature review, the issue of boredom in hospitals frequently came up within the articles. Because of this, it would likely be beneficial to explore the impact that boredom has upon outcomes in hospital-based care. Further exploration into ET's effect on client engagement in therapy and boredom within in a hospital setting would be a recommended next step for follow-up research.

The initial database searches revealed numerous research articles regarding other client diagnoses and conditions, such as TBI and cognitive impairments. Although the research is limited for post-stroke clients in acute care, there may be more extensive research findings if the scope is broadened across diagnoses and/or across the continuum of care. Because of the emerging nature of the research, further exploration of ET use across diagnoses and continuum of care can benefit OT practitioners in increasing ET use in rehabilitation.

Due to the limited time the research team had to monitor the outcomes of the knowledge translation and utilization of the decision chart and list of apps at Harborview, it is recommended that further follow-up on implementation be conducted. The barriers identified by the OT practitioners, as well as a process to make scheduling use of ET available efficient, may increase ET use by OT practitioners during treatment sessions.

Analysis

The project provided a unique learning opportunity for the research team to explore the available research surrounding an emerging area of treatment in practice. The team was able to collaborate with a local clinician who had questions regarding an area of interest shared by the research team. In the beginning, the research team had challenges with the search strategy, including finding a term that would capture only the technology of interest while leaving out other types of technology. With the help of the project chair, Tatiana Kaminsky, PhD, OTR/L and University of Puget Sound librarian, Eli Gandour-Rood, the research team identified the term "everyday technology" and searched a variety of databases to successfully capture all relevant research pertaining to the topic.

Being that the evidence for the use of ET in rehabilitation is relatively new, there is limited high level research on the topic. Many pilot studies were found, but few RCT's have been conducted, lowering the strength of the findings. In addition, many of the studies included applications that were designed specifically for the research study that are not commercially available; meaning, that while the research demonstrated positive outcomes, it may be more difficult to have confidence in implementation of ET in therapy. The research team explored commercially available applications with client performance skills that were similar to the ET interventions used in the research studies.

The chance to present the finding to OT practitioners was a valuable learning experience regarding how to present research findings and materials to professional audiences. It was also a rewarding culmination of the work done across three semesters with a chance to interact and disseminate knowledge to clinicians to begin incorporating new evidence into their practice. Also, by providing an opportunity to get feedback individualized to our findings from OT practitioners, the research team was given a chance to see first-hand the reasons that there can be a 20-year delay between research and implementation in practice.

The research team is proud of the final research paper and is pleased with the positive feedback received from OT practitioners at Harborview, the collaborating clinician, the project chair, and course mentor regarding the culminating work and knowledge translation completed. The research team is looking forward to opportunities to engage in future research and knowledge translation in Fieldwork II placements and work settings.

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"*" before a reference indicates one that appears in the CAT table itself.

Appendix A

Decision Chart

		Fine Motor Skills				Gross Motor Skills				
		Grip	Speed	Dexterity	Bilateral	Coordinate	Reach	Stabilize	Endure	Bilateral
Tablet/Smartphone Apps	Restaurant Games (e.g. Burger Shop)		X	X			*			
	Tracing/ Swiping Games (e.g. Fruit Ninja, Candy Crush)			X			*			
	Food Games (e.g. Pizza Maker)			X			*			
	Word Games (e.g. Words with Friends)		X	X			*			
	Card Games (e.g. Solitaire)			X			*			
	Puzzle Apps (e.g. Jigsaw)			X			*			
	Popping/ Tapping Games e.g. (Bubble Pop, Temple Run)		X	X			*			
	Maze Games (e.g. Maze King)			X			*			
	Tilting Games (e.g. Labyrinth)	X	X		X		*	X		X
	Dexteria (specific game)		X	X			*			
Gaming Console	Wii Sports									
	Bowling	X		X		X	X		X	
	Tennis	X		X			X		X	
	Boxing	X		X			X		X	X
	Golf	X		X		X	X	X	X	X
	Kinect Games				X	X	X	X	X	X

* See specific consideration regarding the set-up of device for eliciting designated motor skill.

Appendix B

Considerations For Decision Chart

1. Access our final paper containing this information on Sound Ideas by Fall 2018! https://soundideas.pugetsound.edu/
2. Client Factors
    1. Hearing and vision impairments may impact effectiveness of technology as intervention. Try changing settings of the game or tablet to support individuals increased participation in technology use.
    2. Client's cognitive abilities such as sequencing and ability to follow instructions may impact effectiveness of technology as intervention
3. Wii/Kinect considerations
    1. If unable to grasp controller, can use universal cuff or coban to strap controller onto hand
    2. Precautions:
        1. Use caution if client has shoulder subluxation or repetitive stress injury
        2. Seizures due to potential symptoms presenting while individual views certain flashing lights or patterns that are common in video games.
        3. Dizziness due to increased risk of falls and injury during standing while playing video games.
        4. Implanted medical devices (check with provider before use) due to Wii manual precautions.
        5. Cardiovascular precautions: avoid large body movements if there are cardiovascular precautions
    3. Seated vs standing
        1. Wii also has game called Wii fit that requires a balance board that would focus on balance as well as UE and LE coordination
        2. All Wii sports games can be played in sitting
4. Tablet Considerations
    1. Position of iPad
        1. Flat on table vs mounted targets require different muscle actions
            1. If tablet is mounted and client is seated, apps can be used to target shoulder flexion
    2. If client is unfamiliar with touchscreen, consider using an easy game such as Scribblekid to introduce the client to its use.

Appendix C

Applications for Upper Extremity Motor Rehabilitation: Smartphone and Tablet

Current smartphone and tablet applications for use in upper extremity motor rehabilitation. Current as of April, 2018. With the nature of technology, these applications may become out of date, or updated quickly, and there are many more applications that could be used that are not on this list. This list is to be used as a reference and also for application ideas. Therapists are encouraged to find other apps that fall into these categories that may be effective in upper extremity motor rehabilitation with their specific clients.

App Category	App	Description	Price ($)	Available on iPhone	Available on Android
Card Games	Solitaire	Fine motor skills, dexterity. Can be mounted to work on gross motor reach.	Free	X	X
	Klondike Solitaire	Requires tapping cards to move them and to display cards from deck. Tracks number of moves, time, and score. No need to play against time.	Free		X
Food Games	Pizza maker	FM skills and finger dexterity. Add ingredients: tap ingredient that flashes. Stir w/ spoon by dragging spoon in circular motion. Stretch dough: drag rolling pin up and down to roll out dough. Create sauce similar to dough. Take sauce, drag “paint” w/ finger sauce on dough. Tap pizza w/ finger to add cheeses and ingredients. Tap to turn on oven and timer. Add additional herbs at end, then select how to set up table. Takes you through steps of food prep.	0.99	X	X
Maze Games	Maze King	Requires fine motor dexterity and finger swipe. Simple → complex mazes. Can play single player or multiplayer mode online.	Free	X	X
Popping/Tapping Games	Bubble Pop	Tap and pop balloons. Finger dexterity, FM weakness and neglect	Free	X	X
	Balloon Party	Tap and pop balloons. Finger dexterity, FM weakness and neglect	Free	X	X
	Temple Run	Emphasize hand-eye coordination and reaction-time, really hard, requires very fast swiping movement/reaction time	Free	X	X
	Piano Master	Tap the piano keys to play music. Finger dexterity, motor control, speed.	2.99	X	X

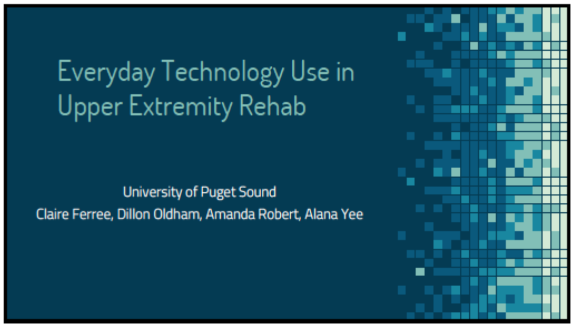
	Diamond Blast	DIAMONDS BLAST: Tapping jewels that match 2 or 3 in a row, or are in clusters. Jewels will disappear and new ones "fall" down to fill spots. This requires speed and accuracy. The jewels are also small in size, since there are so many displayed on the screen at once. Another version is same concept, but a row is added at the bottom every 3 seconds, and you have to tap jewel matches/clusters to prevent them from reaching the top of the screen. This is difficult w/ the constant motion of the jewels to accurately tap the desired jewel.	Free	X	X
	4Kids Maze	MINUTE MAZE MANIA 4 KIDS: using the up/down/left/right arrows on the screen, have the red dot follow the alphabet to complete the maze. Similar to pacman, the cursor has to hit each letter of the alphabet in order. Arrows can be tapped or pressed and held down to move red dot. Speed and accuracy are required, as it is timed. The arrows on the screen can be in the way, since the maze image takes up the whole screen, but there are two sets, so when holding the smartphone horizontally, the arrows can be used by either the left or right fingers. App seems a little outdated.	Free		X
	Maze Craze	Finger tap	Free (& $0.99)		X
	Mahjong	Tapping to select tiles, finger isolation. Matching game, no need for speed. Requires ability to read small tiles, recognize/read Chinese characters.	Free	X	X
	Tap the Frog	Has tapping and dragging games. The game seems to be aimed at young children so it might not be best for adults	Free	X	X
Puzzle Apps	Jigsaw Puzzle	Fine motor dexterity, visual motor, spatial orientation.	Free	X	X
Restaurant Games	Burger Shop	Repetitive hand and wrist gestures. Fine motor dexterity, speed, motor control.	Free	X	X
Tilting Games	Labyrinth	Hand control and wrist/forearm stability. Tilting of the screen is required, and is easiest to use w/ both hands, smartphone horizontally. Accuracy in getting ball to go through maze to get to the end while avoiding the holes. Bilateral use, although can be done one-handed with smartphone.	Free	X	X

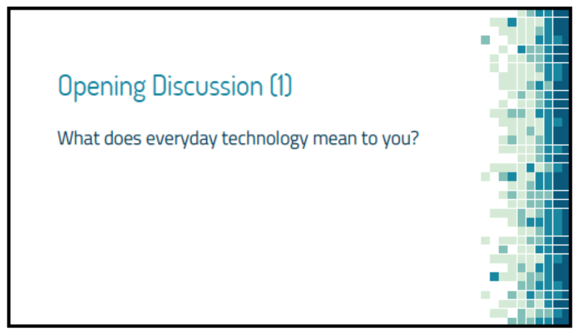
	Marble Maze	Tilting game with ball going through maze in sky (ball can roll off surface and fall, ending the game). Tilting is difficult, and is meant for one hand, and holding the smartphone vertically. Lots of detail in the design of the game, with 3D graphics, but is difficult to see the ball when the ball rolls behind barriers.	Free	X	X
	Maze Tilt	Hand control and wrist/forearm stability. Tilting of the screen is required, and is easiest to use with both hands, smartphone horizontally. Bilateral use, although can be done one-handed with smartphone.	Free	X	X
	Super Space Laser	Emphasize hand-eye coordination, accuracy, and reaction-time. Tilt smartphone to fly ship to find spaceships to destroy with lasers. Difficult to stabilize image/fly ship, and difficult to shoot and fly ship at same time. Firing lasers requires a tap on the screen, but flying ship requires both hands with phone flat.	Free	X	X
Tracing/Swiping Games	Fruit ninja	FM skills and finger dexterity. Swiping motions with one finger (finger isolation) and ability to drag finger across screen. Timed, and requires some speed and accuracy in creating swipe through moving fruit target). Ability to identify fruit from bombs, which you want to avoid. One fruit has you slice as many times as you can in a certain amount of time (~5 seconds), requiring speed).	Free	X	X
	Candy Crush	Displays various game objects on screen, swipe to match three shapes/candies in a row. Requires swiping and accuracy to tap and swipe desired object to desired spot. You can play against time for speed and accuracy or trying to score a certain amount with a limited number of swipes.	Free	X	X
	Tangram	Select and drag shape into appropriate spot in puzzle. Can rotate shape by pressing and holding circle around shape and moving it in circular motion. Must tap screen to get shapes, hard to see shapes, as they appear as faded. Many puzzles to choose from, not timed. Requires form constancy and spatial orientation. Also, no instruction on how to play.	Free	X	X
	Flow Free	Requires finger isolation and cognitive planning (have to drag a finger and plan where to go). There are timed trials (30s, 1 min, 2 min, 4 min) that would make tracking progress easy.	Free	X	X
	Pudding Pop	Requires swiping up/down/left/right to match 3 in a row. Finger isolation, accuracy in selecting and swiping item. Try to beat score with time: fast swiping and spatial orientation & cognitive planning to see where to swipe, and ability to accurately swipe.	Free	X	X

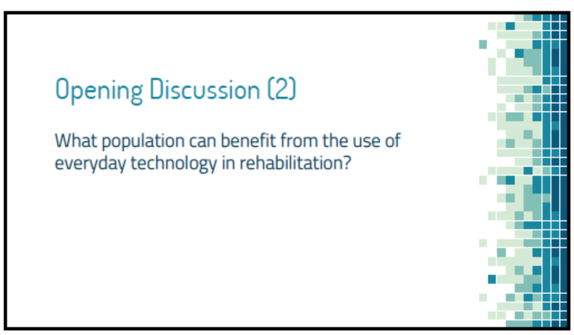
	Jewels Star	Requires swiping up/down/left/right to match 3 in a row. Finger isolation, accuracy in selecting and swiping item. Try to beat score with time: fast swiping and spatial orientation & cognitive planning to see where to swipe, and ability to accurately swipe.	Free	X	X
	Subway Surfers	Emphasize hand-eye coordination and reaction time, catered towards kids, but is an adventure game that is more engaging. Character is running on train tracks, and you have to dodge obstacles by dragging character up/down/left/right at right time to avoid obstacle (character is constantly running or on skateboard). There is also a component where character is being chased by police man, so accuracy in swipes to avoid obstacles that will slow you down is the goal. Requires accuracy of swipe/drag and hand-eye coordination for timing to avoid obstacles.	Free	X	X
	Peglight 2	Ipad. Need for accuracy and speed is low. Large images, no time limit. Used to familiarize clients with touch screen motions.	1.99	X	
	Angry Birds	Swipe, motor control, aim requires FM skills	Free	X	X
	Scribble Kid	Ipad. draw and write name with finger. Used to familiarize clients with touch screen motions. (Android; Kids Doodle)	Free	X	X (Kids Doodle)
Word Games	Words with Friends	Drag, place, tap. Fine motor dexterity and control.	Free	X	X
Other	Findex	Game with assessment and monitoring support to track patients progress during rehab. Game is based on everyday functional activities. Dragging task for finger control, tapping task for finger isolation and coordination, and stretching task for ROM.	Free		X
	Flower Splash	Shoulder abduction/adduction, elbow flexion/extension, wrist pronation/supination	Free		X
	Dexteria	FM skills. Tap it: quickly and accurately isolate finger movements, sequencing, precision. Pinch it: to develop pinch patterns.	4.99	X	

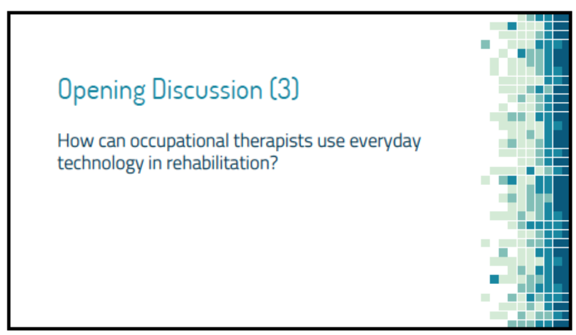
Appendix D

Harborview In-service Presentation









Search criteria & process

Inclusion:

- Everyday technology: off the shelf, commercially available
- Outcomes focusing on upper extremity motor control and/or motivation

Exclusion:

- Robotics, robots
- Augmented communication
- VR with additional equipment/mounts/attachments
- Gaming devices/gaming systems that are not commercially available

Search criteria & process (cont.)

Databases Searched:

- PubMed, CINAHL, OT Seeker, Google Scholar, PEDRO, IEEE Xplore Digital Library, ProQuest Central
- *Journal of Disability and Rehabilitation: Assistive Technology, Journal of Neurorehabilitation, Scandinavian Journal of Occupational Therapy.*

Key Search Terms

- Stroke, post-stroke, cerebrovascular accident (CVA), acquired brain injury (ABI)
- Everyday technology (ET), commercially available technology, iPad, tablet, smartphone, iPhone
- UE motor control
- Motivation

Findings

- Client and clinicians reported increased:
  - satisfaction
  - motivation
  - engagement in post stroke rehabilitation
  - increased upper extremity motor control
- Indicated for use in a variety of settings
- No adverse effects

Application to OT

- Improve UE motor control to increase independence in occupations.
- Could be used to address:
  - Increased social participation
  - Leisure
  - Decreased boredom
  - Sense of independence
  - Increased motivation to engage in therapy
- Could facilitate clients using their own technology for continued engagement in therapeutic activities outside of skilled intervention

Decision Tree

		Fine Motor Skills				Gross Motor Skills				
		Grip	Speed	Dexterity	Bilateral	Coordinate	Reach	Stabilize	Endure	Bilateral
Tablet/Smartphone Apps	Restaurant Games (e.g. Burger Shop)		x	x			*			
	Tracing/ Swiping Games (e.g. Fruit Ninja, Candy Crush)			x			*			
	Food Games (e.g. Pizza Maker)			x			*			
	Word Games (e.g. Words with Friends)		x	x			*			
	Card Games (e.g. Solitaire)			x			*			
	Puzzle Apps (e.g. Jigsaw)			x			*			
	Popping/ Tapping Games e.g. (Bubble Pop, Temple Run)		x	x			*			
	Maze Games (e.g. Maze King)			x			*			
	Tilting Games (e.g. Labyrinth)	x	x		x		*	x		x
	Dexteria (specific game)		x	x			*			
Gaming Console	Wii Sports									
	Bowling	x		x		x	x		x	
	Tennis	x		x			x		x	
	Boxing	x		x			x		x	x
	Golf	x		x		x	x	x	x	x
	Kinect Games				x	x	x	x	x	x

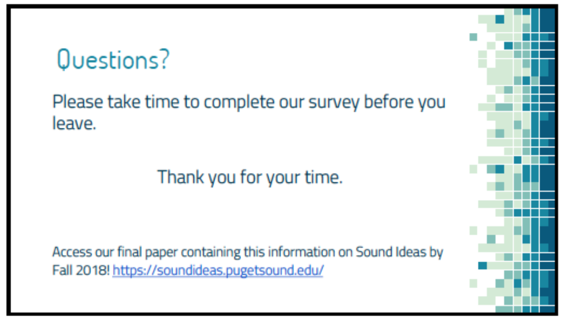
* See specific consideration regarding the set-up of device for eliciting designated motor skill.

Considerations

Considerations regarding decision chart use

- Visual and/or hearing impairments
- Cognitive abilities: sequencing, following instructions
- **Kinect/Wii:** Standing vs. seated
  - Repetitive stress injury
  - Dizziness
  - Seizures
  - Cardiovascular precautions
- **iPad**: mounted vs. handheld
- Familiarity with touchscreen


How you can use Everyday Technology
Main takeaway
Evidence supports use of everyday technology as treatment to improve UE motor function and increase engagement.
Success in OT settings across continuum of care show promising implementation into hospital-based therapy.
Use clinical reasoning when making decisions regarding everyday technology with clients.
Apps to Explore
Dexteria, Bubble Tap, Fruit Ninja, Tangrams, Mazes, Flow Free


Questions?
Please take time to complete our survey before you leave.
Thank you for your time.
Access our final paper containing this information on Sound Ideas by Fall 2018! https://soundideas.pugetsound.edu/

Appendix E

Harborview In-service Flyer

Everyday Technology Use in Upper Extremity Rehab in Patients Post-Stroke

WHEN

April 11th
12:15pm – 12:50pm

WHERE

Therapy Gym
Harborview Medical Center

Presenters: **University of Puget Sound occupational therapy students**

Est. 1888
UNIVERSITY of PUGET SOUND

CURRENT RESEARCH

Tablet Use
Gaming Console Use
Client Engagement

APPLICATION IN OCCUPATIONAL THERAPY

Hospital-based interventions

HANDS ON OPPORTUNITY

Join us to discuss technology-based interventions and try them out

ALL OCCUPATIONAL THERAPISTS WELCOME

We hope to see you there!

Images retrieved from:

https://www.bestbuy.com/site/apple-ipad-5th-generation-with-wifi-32gb-space-gray/4907703.p?skuId=4907703

https://www.pugetsound.edu/about/offices-services/office-of-communications/communications-new/creative/visual-identity/primarylogo/primary-logo/

http://saimaya.es/es/consolas/4955-10016003.html

Appendix F

Harborview In-service Survey

Please answer the following questions to aid us in evaluating the effectiveness of this in-service and determining additional resources that may be helpful in applying this information.

1. How likely were you before this in-service to use everyday technology in treatment interventions? *(Please circle one)*

   Not at all   Not likely   Somewhat likely   Very Likely

2. How likely are you, now, after the in-service to use everyday technology in treatment interventions? *(Please circle one)*

   Not at all   Not likely   Somewhat likely   Very Likely

3. What are ongoing barriers to everyday technology use in treatment interventions? *(Please circle all that apply)*

   Sharing technology with other therapists   Treatment time   Unfamiliar with technology   Inappropriate for patients

Other: ____

4. What additional resources would you need to implement everyday technology use in treatment interventions?

   ____

   ____

   ____

   ____

Permission for Scholarly Use of Thesis

Name: ____ Date: ______________________

____
Signature of MSOT Student

Name: ____ Date: ______________________

____
Signature of MSOT Student

Name: ____ Date: ______________________

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Signature of MSOT Student

Name: ____ Date: ______________________

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Signature of MSOT Student