5-2016

# Four Effective and Feasible Interventions for Hemi-inattention Post CVA: Systematic Review and Collaboration for Knowledge Translation in an Inpatient Rehab Setting.

Elizabeth Armbrust
*University of Puget Sound*

Domonique Herrin
*University of Puget Sound*

Christi Lewallen
*University of Puget Sound*

Karin Van Duzer
*University of Puget Sound*

# Four Effective and Feasible Interventions for Hemi-inattention Post CVA: Systematic Review and Collaboration for Knowledge Translation in an Inpatient Rehab Setting.

May 2016

This evidence project, submitted by

Elizabeth Armbrust, OTS

Domonique Herrin, OTS

Christi Lewallen, OTS

Karin Van Duzer, OTS

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.

_____
Project Chairperson: Tatiana Kaminsky, PhD, OTR/L

_____ _____
OT635/636 Instructors: George Tomlin, PhD, OTR/L, FAOTA; Sue Doyle, PhD, OTR/L, CFE

_____
Director, Occupational Therapy Program: Yvonne Swinth, PhD, OTR/L, FAOTA

_____
Dean of Graduate Studies: Sunil Kukreja, PhD

Key words: hemi-inattention, intervention, knowledge translation, inpatient, occupational therapy

## Abstract

*Purpose*: To locate, evaluate, and summarize the evidence for effective and feasible interventions to treat hemi-inattention in inpatient rehabilitation settings and ensure knowledge translation with a collaborating clinician Timothy Rich, OTR/L and his team at Harborview Medical Center. *Design*: Systematic literature review, participatory active research with a collaborating clinician, and knowledge translation. *Methods*: Included studies that tested effectiveness of mirror therapy (MT), transcutaneous electric nerve stimulation (TENS), limb activation therapy (LAT), and visual scanning therapy (VST). 11 databases were searched to yield 31 articles included in a critically appraised topic (CAT) table. A concise protocol for each intervention was then provided to participating clinicians at an in-service training. A follow-up survey was completed to assess the degree of knowledge translation that had occurred which resulted in a positive response. *Conclusion:* There is evidence for the effectiveness of VST, TENS, LAT and MT to treat hemi-inattention. Combined interventions were often more effective than when used individually. It is suggested that further research be conducted to address the advisability of a multi-contextual approach to VST in order to maximize generalization to functional tasks in a variety of natural environments.

## Executive Summary

This project was conceived as a way to facilitate knowledge transfer between researchers and clinicians through a collaborative effort between practicing clinicians and students. The authors are four graduate students collaborating with a clinician in a highly active inpatient rehabilitation setting to promote evidence-based decision making when selecting interventions for use with patients who have a diagnosis of hemi-inattention post CVA. Hemi-inattention is a common complication post CVA that can negatively impact therapy outcomes. Inpatient rehabilitation settings have barriers that limit occupational therapists' ability to implement evidence based interventions for treatment of hemi-inattention due to a lack of time and resources.

The authors collaborated with a clinician to develop a researchable question that required them to locate, evaluate, and summarize the evidence, including implementation feasibility, for use of mirror therapy (MT), transcutaneous electric nerve stimulation (TENS), limb activation therapy (LAT) and visual scanning therapy (VST) to treat hemi-inattention in inpatient rehabilitation settings. Inclusion and exclusion criteria were developed and 11 databases were searched yielding a total of 31 articles included in a critically appraised topic (CAT) table. The quality of included articles was rated using the PEDro scale. A feasibility table was created to summarize the relevant factors for each of the four interventions. Supports and barriers to implementation of each intervention within the practice setting were identified in order to create knowledge translation products that would meet the needs of the clinicians involved.

Studies ranged in quality from fair to high with mixed conclusions among the studies about relative effectiveness. However, there is evidence to support the use of each of the four interventions singly and/or in concert or series with another intervention. VST proved effective

in the inpatient (IP) setting with concerns about the generalizability of the skill, thus using it with a multicontextual approach may be helpful, though more research is needed to determine the impact of this approach on transfer of VST. Combined interventions were often more effective than when used individually, specifically with TENS and/or VST. MT is primarily used to promote motor return post CVA, however, there is evidence to support its use for hemi-inattention with gains maintained 6 months post treatment. Active and passive LAT are effective and can be used in conjunction with TENS or VST.

A concise protocol for each intervention, based on the commonalities of the protocols used in the research articles, was produced and, along with some background on the project, presented to seven clinicians at an in-service training. Participating clinicians completed a survey to assess the degree of knowledge translation that had occurred, the likelihood of implementation of the interventions, and to provide feedback on the protocols. Responses were good and most participants indicated that they were likely to implement the evidence presented into their practice and that they did not feel it would be particularly hard to do so. Questions asked during the in-service demonstrated that the clinicians were, indeed, considering how to implement the interventions in their regular practice.

Knowledge translation can be a slow process that may result in effective treatment interventions entering into common practice many years after they have been found effective and protocols established through research. This project encompassed all the required steps to bring good quality research directly to practicing clinicians providing them with recommended protocols that can be immediately implemented along with the evidence to support their use.

# Final Revised CAT Table

**Focused Question:**

Which intervention(s) are most effective and could be reasonably and inexpensively implemented in the hospital inpatient rehab setting for adults with hemi-inattention post CVA? We searched this based on the following two questions:

1. Which intervention/s available to occupational therapists is the most effective for remediating hemi-inattention post CVA?

2. What is the most pragmatically feasible intervention for hemi-inattention post CVA for this hospital inpatient rehabilitation setting?

**Prepared By:**

Elizabeth Armbrust, Domonique Herrin, Christi Lewallen, & Karin Van Duzer

**Date Review Completed:**

November 15, 2015

**Clinical Scenario:**

An occupational therapist at an inpatient rehabilitation clinic is wondering what the most effective and pragmatically feasible intervention/s are for patients with hemi-inattention secondary to stroke that are available to occupational therapists in a hospital inpatient rehabilitation facility.

**Review Process: Procedures for the selection and appraisal of articles**

**Inclusion criteria:**

- Studies published in English from 2000 to present.
- Adult stroke patients with diagnosis of hemi-inattention (or related synonym).

- Studies related to the following interventions, Visual Scanning Therapy, Transcutaneous Electrical Nerve Stimulation, Limb Activation, and Mirror Therapy were chosen after consultation with faculty mentors, the research chair, and the collaborating clinician. It was determined that these interventions would likely be the most feasible for an inpatient rehabilitation setting, and were able to be used by an occupational therapist.
- Systematic Reviews/Meta Analyses for post stroke intervention that included at least one of the above listed interventions and the impact on hemi-inattention as an outcome.

**Exclusion Criteria:**

- Diagnosis of hemi-inattention due to something other than CVA (e.g., TBI).
- Studies of interventions that do not include at least one of the four listed above.
- Studies on non-human subjects.
- Studies on individuals < 18 years of age.
- Interventions that are outside of the practice of OT (e.g., prisms and transcranial magnetic stimulation)
- Non-research papers (editorials, opinion papers, general information)

### Search Strategy

Table 1: Search terms by category

| Categories | Key Search Terms |
|---|---|
| Diagnosis | Hemi-inattention, Hemineglect, Unilateral inattention, Unilateral neglect, Visual inattention, Hemispatial neglect, Right neglect, Left neglect, Hemispatial inattention, Visual hemispatial inattention, Hemiagnosia, Neglect Syndrome, Contralateral hemispatialagnosia |
| Client population | Stroke, Cerebral vascular accident, Cerebral ischemic, Cerebral thrombosis, CVA |
| Interventions | Visual Scanning Therapy (aka VST, Lighthouse), Transcutaneous Electrical Nerve Stimulation (aka TENS, Somatosensory Stimulation, Somatosensory electrostimulation), Mirror Therapy, Limb Activation Therapy |
| Comparisons | Effective, Feasible, Cost-effective |

Table 2: Databases and sites used in search strategy

| Databases and Sites Searched |
|---|
| Pubmed/Medline |
| Google Scholar |
| CINAHL |
| Cochrane Library |
| Stroke Engine |
| OT Seeker |
| American Journal of Occupational Therapy |
| British Journal of Occupational Therapy |
| Canadian Journal of Occupational Therapy |
| International Stroke |
| Evidence-Based Review of Stroke Rehabilitation |
| Google Scholar |

***Search Strategy Outline:***

1. Search used each of the databases listed in Table 2: Enter a, b, and c into each search engine plus one string of terms from step "d". Example a + b + c + d:i. Using PubMed to search: Hemi-inattention (with synonyms) + Stroke (with synonyms) + Treatment (with synonyms) yielded 1074 results. Then adding VST (with synonyms) = yielded 106 articles. After completing this first step all returned articles were briefly reviewed for relevancy and the inclusion and exclusion criteria were applied. All remaining articles were reviewed for quality using published measures of research quality appropriate to the research design.
    a. (Hemi-inattention OR Hemineglect OR Unilateral inattention OR Unilateral neglect OR Visual inattention OR Hemispatial neglect OR Right neglect OR Left neglect OR Hemispatial inattention OR Visual hemispatial inattention OR Hemiagnosia OR Neglect Syndrome OR Contralateral hemispatialagnosia)
    b. AND: (Stroke OR Cerebral vascular accident OR Cerebral ischemic OR Cerebral thrombosis OR CVA)
    c. AND: (Treatment OR Rehabilitation OR Intervention OR Therapy)
    d. AND:
        i. (Visual Scanning Therapy OR Lighthouse Therapy OR VST)
        ii. (Transcutaneous Electrical Nerve Stimulation OR Somatosensory Stimulation OR Somatosensory electrostimulation OR TENS)
        iii. Mirror Therapy
        iv. Limb Activation Therapy
2. Several search engines were unable to process the number of key terms in the initial search (part 1), and instead variations of the terms were used as detailed below:

a. Visual scanning therapy
b. Neglect AND (visual scanning)
c. (Hemi-inattention OR hemineglect OR unilateral inattention OR unilateral neglect) AND (visual scanning therapy OR lighthouse therapy OR VST) AND (treatment OR rehabilitation OR intervention OR therapy) AND (stroke OR cerebral vascular accident OR CVA)
d. (Hemi-inattention OR hemineglect OR unilateral inattention OR unilateral neglect) AND (visual scanning therapy OR lighthouse therapy OR VST) NOT pharmacological NOT (eye patching) NOT (limb activation) NOT (TENS) NOT (mirror therapy)
e. TENS AND CVA
f. (TENS OR transcutaneous electrical nerve stimulation) AND (stroke OR CVA) AND (hemi inattention OR unilateral neglect)
g. Unilateral neglect mirror therapy
h. (CVA OR stroke) AND (mirror therapy OR mirror box) AND (hemi inattention OR unilateral neglect) NOT pharmacological
i. Neglect AND limb activation therapy
j. Limb activation
k. (Hemi inattention OR "unilateral neglect") AND ("limb activation") AND (CVA or stroke) AND (intervention OR treatment) NOT (pharmacological OR cognitive) NOT (TBI)

3. The second part of the researchable question is addressed through review of the articles retained from step one of our search. The articles are then carefully reviewed for content and

searched for information relevant to cost-effectiveness, training required, dosage and frequency, ease of implementation, and adverse effects.

**Results of Search:**

Table 3. Articles listed by study design and Pyramid Evidence level

| Pyramid Evidence Level | Study Design | Number of Articles Selected |
|---|---|---|
| Experimental | 8 Meta-Analyses of Experimental Trials | 28 |
| | 14 Individual Blinded Randomized Controlled Trials | |
| | 3 Controlled Clinical Trials | |
| | 3 Single Subject Studies | |
| Outcome | 2 One Group Pre-Post Studies | 3 |
| Qualitative | 0 | 0 |
| Descriptive | 0 | 0 |
| | | Total Number of Articles: 31 |

**Quality Control/Peer Review Process:**

The research question began to develop during an initial meeting with the clinician collaborator to discuss the need for research into effective interventions to treat hemi-inattention post-CVA. Our project chair helped to refine the early ideas into a well-built, searchable question. Through team meetings, discussions with our faculty mentor, and interactions with the clinician collaborator, a list of inpatient setting-specific interventions were constructed. To catalog the resulting journal articles, the University of Puget Sound Occupational Therapy library liaison was consulted to establish a RefWorks citation system for better organization of resources.

The search strategy shown above was developed by the team and revised through peer and faculty review, then divided by interventions to be searched by each member of the research group. For each database searched the group member entered hemi-inattention plus all synonyms AND stroke plus all synonyms AND therapy plus all synonyms AND the specific intervention plus any synonyms. The resulting list of articles was limited to the years 2000-2015 then reviewed for any duplicates from prior searches of other databases. Each article in the list was then checked for relevance to the intervention and the client population and screened for inclusion and exclusion criteria. Any articles remaining were collected in the group's RefWorks account and organized by intervention or, if comparing interventions, put in a general folder. Across all four intervention searches, 1065 articles were found.

For Visual Scanning Therapy, there were 276 hits of which 37 were duplicates. Using the exclusion criteria, we removed a further 228 for the following reasons: 43 not VST, 2 not diagnosis, 171 neither VST nor diagnosis, 8 not research, 1 not English, 2 before 2000, 1 not human subjects. This process yielded 11 articles regarding VST included in the CAT table.

For TENS, there were 162 hits of which 18 were duplicates. Using the exclusion criteria, we removed a further 136 for the following reasons: 22 not TENS, 9 not diagnosis, 99 neither TENS nor diagnosis, 7 not research. This process yielded 7 articles regarding TENS included in the CAT table.

For Mirror Therapy, there were 207 hits of which 33 were duplicates. Using the exclusion criteria, we removed a further 167 for the following reasons: 26 not MT, 31 not diagnosis, 103 neither MT nor diagnosis, 5 not research, 1 not in English, 1 not adults. This process yielded 7 articles regarding MT included in the CAT table.

For Limb Activation Training, there were 420 hits of which 15 were duplicates. Using the exclusion criteria, we removed a further 400 for the following reasons: 36 not LAT, 1 not diagnosis, 360 neither LAT nor diagnosis, 1 not research, 1 before 2000. This process yielded 6 articles regarding LAT included in the CAT table. In total we included 31 articles related to at least one of the four interventions. For a visual representation of the search and exclusion process see Figure 1, see Table 3 for summary of articles included in CAT.

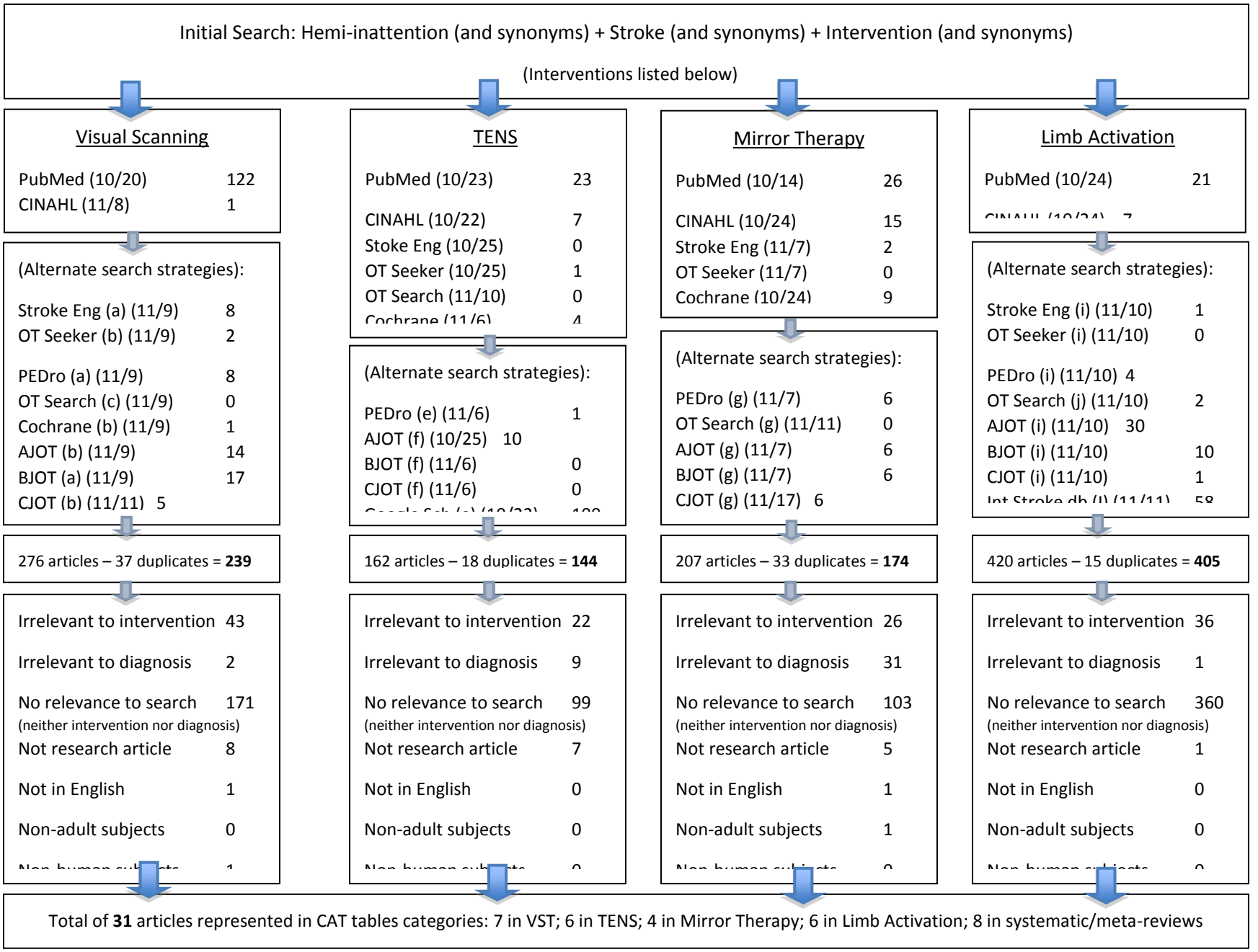



**Figure 1. Search results by database; see Search Strategies section part 2 for list of additional strategies (a) – (k)**

| VST – Quantitative: experimental studies | | | | | | |
|---|---|---|---|---|---|---|
| **Author, Year** | **Study Objectives** | **Study Design/ Level of Evidence** | **Participants: Sample Size, Description Inclusion and Exclusion Criteria** | **Interventions & Outcome Measures** | **Summary of Results** | **Study Limitations** |
| Bailey, Riddoch, & Crome, (2002) | Evaluate the use of 2 approaches (VST and LAT) to reduce unilateral visual neglect (UVN) in people who have had strokes | Single-Subject Study,ABA design.<br><br>Pyramid Evidence Level = E4<br><br>AOTA Evidence Level = III | N=7, stroke, severe L UVN, age 60-85, admitted from acute care to stroke rehab unit over a 12 month period. Average duration since stroke was 28 days. | I= 10 sessions, 1 hour, alternate weekdays, in the morning. Randomly assigned to 2-, 3-, or 4-week baseline phase. Continued OT and PT throughout all phases (30 mins a week). Patients without voluntary UE movement allocated to scanning and cueing approach (n=5). Patients with voluntary UE movement allocated to contralesional limb activation approach (n=2). O= scores on star cancellation test, line bisection test, baking tray task. The VST group was encouraged to scan from left to right in writing, visual searching, and reading tasks. The LAT group was asked to only move their affected LUE during tasks, voluntary movement used when possible, during functional/goal oriented | Both subjects treated w/ LAT and 3/5 subjects using VST improved scores with statistical significance on one or more of the 3 outcome measures. Kruskal-Wallis Test across phases: Subject 1 ($p$ = 7.07), 2 ($p$ = 0.086), 3 (*n/a)*, 4 ($p$ = 0.041*)*, 5 ($p$ = 0.651), 6, ($p$ = 0.003), and 7 (*n/a)*, and Mann-Whitney Post Hoc Tests between phases. Both VST and LLA strategies appeared to be effective in 5/7 pts, but no evidence for generalizability to untrained tasks was found. Authors caution use of results without further research with | May not be generalizable due to not using functional activities. Results possibly due to spontaneous recovery or simultaneously receiving OT/PT. Encouraged in therapy to look towards L side. Small sample size. No control group was present, and groups were heterogeneous, likely placing more severe cases in the VST group. |

| | | | | | | |
|---|---|---|---|---|---|---|
| | | | | activities (like shaving, applying makeup, dressing, etc.). | a larger sample size and control group. | |
| Kerkhoff, Bucher, Brasse, Leonhart, Holzgraefe, Volzke, Keller, & Reinhart (2014) | Compare the effects of smooth pursuit eye movement training to visual scanning training in post-acute stroke patients after 1 month with left neglect. | A single blind randomized controlled trial.<br><br>Pyramid Evidence Level = E2<br><br>AOTA Evidence Level = I | *N*= 24 randomized, *n* = 12 in each group. Age, M = 65 (3); days since stroke = 37 (5). Inclusion criteria: single right-hemisphere stroke, visual neglect determined by 2 screenings, and able to participate in daily neglect training for 30 min. Exclusion criteria: disease of psychiatric, ophthalmological or other neurological origin. | *I*= Interventions were 20 sessions for 30 min each for one month. One group completed scanning random displays of 20-60 identically colored and sized squares moving horizontally (SPT). The other group viewed stationary displays of stimuli in the same software (VST) and cued to scan systematically.<br>*O*=FNI, UBNI, Help Index, Barthel Index, and Rehabilitation status. | The pairwise comparisons for SPT from baseline to follow-up were significant across all outcomes: Barthel index mean difference = -21.87, $p$ = <.001, FNI mean difference = -5.16, $p$ <.001, UBNI mean difference = 0.37, $p$ =.001, and the Help index mean difference = 0.74, $p$<.001. Only the baseline-follow up difference for rehabilitation phase was significant for VST ($Z$ = 1.73, $p$ =.083). Authors conclude that bedside SPT has a more significant effect than VST. | Without a second baseline, it is unclear whether the improvements were from the interventions or spontaneous recovery.<br>Lack of a control group, not receiving treatment, raises concerns that spontaneous recovery could have had an effect. |

| | | | | | | |
|---|---|---|---|---|---|---|
| Kerkhoff, Reinhart, Ziegler, Artinger, Marquardt, & Keller, (2013) | Compare effects of SPT and VST on auditory and visual neglect in chronic stroke patients | Randomized Controlled Trial. Pyramid Evidence Level = E2 AOTA Evidence Level = I | *N*=50, 5 pts. d/c before completion. R CVA w/ L neglect recruited. Inclusion criteria: visual neglect dx by outcome baseline, tolerate 50 min in w/c, and a minimum stay of 6 wks. Exclusion criteria: hx of cerebrovascular disease and psychiatric disorders. VST mean age was 59.24, and for SPT was 58.50. VST mean months since stroke was 5.24, and for SPT was 3.58. | I= 5, 50 min sessions, 7-9 days, 6 wks in clinic. Randomly allocated to SPT (n=24) or VST (n=21). SPT used moving visual stimuli; VST used static visual stimuli. Concurrently received standard OT/PT. No treatment 2 weeks before intervention, follow-up 2 weeks after treatment period. O= % omissions in cancellation tasks, % paragraph reading, LBT, and the auditory midline test. | A 2x2x3 ANOVA with factors Group, Side, and Time. Auditory midline test, main effect found for SPT ($F$[2, 42] = 15.31, $p$ <0.001) but not for VST; paragraph reading: SPT ($F$[2, 42] = 22.20, $p$ < 0.001); line bisection: SPT ($F$[2, 42] = 5.90, $p$ = .006); motor line bisection: SPT ($F$[2, 42] = 8.07 $p$ = 0.001); single digit cancellation ($F$[2, 42] = 19.47.07 $p$ = 0.001); double digit cancellation ($F$[2, 42] = 24.04 $p$ < 0.001). Authors concluded that SPT significantly more effective than VST within a short treatment duration (5hrs) at reducing visual neglect. It also significantly improves auditory neglect and the auditory midline. | Did not include functional outcome measures. Few treatment sessions. Did not address personal or extrapersonal neglect, only peripersonal. |

| | | | | | | |
|---|---|---|---|---|---|---|
| Luukkainen-Markkula, Tarkka, Pitkanen, Sivenius, & Hamalainen, (2009) | Evaluate whether left arm limb activation improves symptoms of neglect as compared to VST. | Randomized Controlled Trial<br><br>Pyramid Evidence Level = E2<br><br>AOTA Evidence Level = I | *N*=12 Pts at rehab facility, < 6 mo post right hemispheric stroke. *n* = 6 in each group: LA and VST. Inclusion criteria: first stroke, hemispatial neglect dx through BIT, BIT C, or CBS OT. Exclusion criteria: left handed, comorbid dx, cognitive decline, or unable to cooperate with study. LA mean age = 59.5 and VST = 57.8. LA mean time since stroke = 81.0 days, VST = 95.5 days. | I= 48 hours of therapy, 3 weeks. Both groups received rehab in the acute ward and health center, physiotherapy, occupational therapy, and group therapies. One group received VST while the other received LA. Total hrs of therapy: VST (46.7 ± 2.1), LA (49.3 ± 2.9). O= FIM, BIT, CBS OT, 6 sub-tests from WMS-R, 2 subtests from Rey Osterrieth, 2 subtests from List learning, and BDI. | Statistically significant recovery for LA on BIT C ($p$ = 0.006), and CBS OT ($p$ = 0.002). For VST on BIT C ($p \leq$ 0.001), MMAS ($p$ = 0.031), a decrease in perseveration mistakes on motor learning test ($p$ = 0.063) and improvement copying Rey figure (p = 0.063). Both groups improved on the FIM ($p$ = 0.031). LA is about as effective as traditional VST when not used simultaneously. May be effective for pts who have limited co-operation. More effective when VST combined with physiotherapy and occupational therapy. | The varying amounts of therapy time, while realistic in this setting, could have caused treatment effects. A small sample size may have also had effects on the results. Treatment was done within the first 6 months of stroke, thus results could be due to spontaneous recovery. Additionally, the LA group received .2 hrs of VST while the VST group received no LA. The hrs of LA received was 3 times that of VST. |

| | | | | | | |
|---|---|---|---|---|---|---|
| van Wyk, Eksteen, & Rheeder, (2014) | Determine the effectiveness of VSEs combined with physiotherapy with patients presenting with USN post stroke. | A matched pair, double blind, randomized control trial.<br><br>Pyramid Evidence Level = E2<br><br>AOTA Evidence Level = I Level = III | *N* = 24 participants (determined need for 80% power) divided into 2 groups, *n* = 12. Participants 19-74 years old, 1-3 weeks post stroke in rehab unit of the GRC. Exclusion criteria: <7 on MMSE, hx of psychiatric problems, comorbid condition, or involved in other rehab or pharmacological studies. | *I* = Treatment consisted of 45 minute sessions 5 days a week for 4 weeks. Group 1 received visual scanning exercises combined with saccadic eye movement training during task-specific activities. Group 2 received only task-specific activities.<br><br>*O* = The International Classification of Functioning, Disability and Health was used as a model for assessment and treatment. Assessment of visual scanning and oculomotor function was done through the King-Devick Test and SCT. Functional activity level was assessed with the BI. | Significant difference on the 3rd subtask of the King-Devick assessment for Group 1 (*p*= .02). Group 1 scores were also more significant than group 2 for the SCT (*p* = .02). Group 1 had a statistically significant increase in their scores on the BI, while group 2 did not.<br>Authors concluded that saccadic eye movement training along with VST significantly improved unilateral spatial neglect and improved pts. visual perceptual processing with secondary benefits in functional ability. | The small number of participants in the study could have limited the power and contributed to a type II error. Participants were sampled from the GRC which could have contributed to a selection bias and limited the generalizability of the results. Intervention group combined saccadic eye movements and VSE, making it difficult to determine which intervention had an effect. |

| | | | | | | |
|---|---|---|---|---|---|---|
| Ferreira, Lopes, Luiz, Cardoso, & André (2011) | To compare the effectiveness of VST and mental practice on tests and ADL for patients with chronic stroke and hemispatial neglect. | A randomized controlled trial.<br><br>Pyramid Evidence Level = E2<br><br>AOTA Evidence Level = I | *N* = 15, *n* = 5 in each group. Inclusion criteria: ischemic R hemispheric stroke, onset >3 mo prior. No group means were reported. Exclusion criteria: locomotor problems, ataxia that could interfere with task completion, dysphasia, Parkinson's disease, dementia, and other neurodegenerative conditions. | *I* = Interventions were VST and mental practice. VST consisted of 4 tasks (15 min duration each). 2 tasks addressed extrapersonal space and 2 peripersonal. Pts scanned from the left side and the task was graded as the pt improved. If they missed an object during VST they were encouraged to restart scanning directly before the object they missed.<br>*0* = BIT, FIM | VST group had significant decreases in neglect symptoms as determined by the BIT pre and immediately after treatment. The scores had significantly higher changes when compared to the control and mental practice groups ($p$ = 0.047). Changes were maintained immediately after and at follow up ($p$ = 0.043). No significant differences were found on the FIM in any of the groups. The authors found VST to be low cost, easy to administer, and could significantly increase outcomes in a 5-week period. | The control group was made of 5 individuals who did not want to participate in any intervention. This could have biased the sample. |

| VST – Quantitative: outcome studies | | | | | | |
|---|---|---|---|---|---|---|
| **Author, year** | **Study Objectives** | **Study Design/ Level of Evidence** | **Participants: Sample Size, Description inclusion exclusion criteria** | **Interventions & Outcome Measures** | **Summary of Results** | **Study Limitations** |
| Piccardi, Nic, Bureca, Matano, & Guariglia (2006) | To determine the effectiveness of VST on hemineglect in pts post CVA who also had an attention deficit. | One group pre-post study.<br><br>Pyramid Evidence Level = O4<br><br>AOTA Evidence Level = III | *N* = 7 sampled from the Fondazione Santa Lucia inpatient hospital. Inclusion criteria: unilateral neglect secondary to stroke and successful completion of a neurological assessment. Exclusion criterion: comorbid psychiatric diagnoses. Mean age = 67.57 years. Mean time since stroke = 2 months. | *I* = pts received 45 min of VST treatment 5 days a week for 2 months. Grading individualized to each pt. Treatment consisted of VST strategies applied to visual-spatial scanning, reading and copying, copying of line drawings, and description of scenes. *O* = For assessment of hemispatial neglect the following tests were used: Line Cancellation test, Letter Cancellation test, Bells test, Serving tea, Card dealing, Use of common objects, picture description, description of a room. For assessment of attention, the following assessments were used: Alertness test, Go/No-Go test, and Vigilance test. | Pts. had significant improvement in visuo-spatial neglect symptoms, ($F$ = 51.839, $p < 0.001$) and functional neglect symptoms ($t$ = 3.637, $p < 0.011$) Authors conclude that pts need a variety of therapeutic approaches for cases with neglect and attentional disorders and that pts maintain sensitivity to VST despite a pervasive disorder. | Only 1 outcome measure was used for personal neglect while there were 4 for peripersonal, and 3 for extrapersonal. Small sample size and no control group limited the generalizability of the study. |

| TENS – Quantitative: experimental studies | | | | | | |
|---|---|---|---|---|---|---|
| **Author, Year** | **Study Objectives** | **Study Design/ Level of Evidence** | **Participants: Sample Size, Description Inclusion and Exclusion Criteria** | **Interventions & Outcome Measures** | **Summary of Results** | **Study Limitations** |
| Guariglia, Coriale, Cosentino, & Pizzamiglio, (2000) | Test the effect of TENS on spatial reorientation in patients with neglect. | Controlled clinical trial.<br><br>Pyramid Evidence Level = E3<br><br>AOTA Evidence Level = III | *N* = 12 participants, hemispatial neglect following R CVA. Inclusion: Single unilateral lesion. Exclusion: history of psychiatric disorders or signs of dementia. | *I* = Participants performed orientation tasks in white room and visually cued room with and without TENS applied to left neck.<br><br>*O*= Responses based on orientation questions in each room. | White room: orientation performance improved with TENS, (t = 4.614, $p < 0.01$).<br>Cued room: orientation performance improved in both groups, without significant difference between them, (t = 0.157, n.s.) | No indication of continued effects; no description of participant recruitment or demographics; no information about assessors to determine bias/no bias; validity of measure unknown. |
| Lafosse, Kerckhofs, Troch, & Vandenbussche, (2003) | Compare effectiveness of CPA to TENS for L hemispatial neglect due to stroke. | Controlled clinical trial.<br><br>Pyramid Evidence Level = E3<br><br>AOTA Evidence Level = III | First experiment (A) *N* = 13, (8 males, 5 females) with L visuospatial neglect; right handed, R CVA. Mean age 62.9 years (*SD* 9.9; range 49-76) mean time since stroke 122 days (*SD* 95; range 22-181 days). Exclusion: hx of prior CVA, dementia, other neurological or | *I* =(A*)* Four stimulation procedures, (1) TENS, (2) CPA, (3) TENS + CPA, (4) placebo; one procedure per day applied to contralesional UE for 15 min so that each participate received each procedure, randomly ordered, procedure over 4 days within 1 week. (B) Same sequence as in experiment A, but applied twice to subset group under two conditions, one was with TENS below the motor | Star Cancellation: (A) Improvement shown only for single TENS condition, $F(3, 36) = 4.29$, $p = .011$. (B) Improvements shown with settings above proprioceptive threshold in TENS directly post stimulation $F(1, 6) = 37.55$, $p<.001$.<br>Line Bisection: (A) Deviation percentage significantly affected following the | Small sample size; no control group; difficult to generalize to functional tasks; difficult to tell if training to task confounded outcomes. |

| | | | | | | |
|---|---|---|---|---|---|---|
| | | | psychological problems. Second experiment (B) , N= 7, subset of original group, presenting with somatosensory loss. | (proprioceptive) threshold and one with TENS at the level at which a visible contraction was elicited, based on the individual.<br><br>*O* = Measure expression of neglect: Star Cancellation Test and Line Bisection Task performed at 4 points in time during session: baseline; during stimulation; immediately after;30 min after. | application of TENS, $F(3, 33) = 3.77$; $p = 0.020$. (B) Again, improvement shown with TENS setting above proproceptive threshold, $F(1, 6) = 22.69$, $p = .003$. | |
| Pérennou, Leblond, Amblard, Micallef, Hérisson, & Pélissier, (2001) | Test effect of TENS on postural instability due to neglect related changes in internal representation of space after stroke. | Case controlled study and controlled trial<br><br>Pyramid Evidence Level = E3/O3<br><br>AOTA Evidence Level = III | *N* = 36, 22 participants averaged 83 days s/p stroke (mean age 58.3± 2.5 years), and 14 age-matched healthy subjects; <75yo, supratentorial CVA, able to perform postural task. Exclusion: psychiatric disorders, previous balance issues, pacemaker. | *I* = Dynamic balance task with and without TENS. TENS and placebo applied via 2 electrodes to skin over dorsal region of sternocleidomastoid.<br><br>*O* = Measures: postural performance by number of aborted trials and angular dispersion of support (using Vicon optoelectronic system). Assessing effect of TENS on neglect-related internal representation in space. | TENS improved postural stability in patients with neglect ($F_{1,36} = 9$: $p = .005$) and null in patients s/p CVA without neglect LN- ($F_{1,48} = 2.2$: $p = .15$), RL- ($F_{1,48} = .06$: $p = .80$) and healthy subjects (no baseline instability). Strengthens the idea of a neglect-related component to postural instability and effectiveness of TENS as its treatment. | Effects did not last beyond 20 minutes; tilt limited by device to 17° - considered aborted attempt; not transferable to use outside of clinic; did not retest effect of TENS with traditional neglect-related outcome measures. |

| | | | | | | |
|---|---|---|---|---|---|---|
| Polanowska, Seniów, Paprot, Leśniak, & Czlonkowska (2009) | Determine the effectiveness of left-hand e-stim for pts. with left visuo-spatial neglect post stroke. | Randomized double blind controlled trial.<br><br>Pyramid Evidence Level = E2<br><br>AOTA Evidence Level = 1 | *N* = 40 (25 men, 15 women). Inclusion: right cerebral hemisphere stroke and secondary visuo-spatial neglect, first stroke, right handed, verbally intact, and gave informed consent. Participants randomly assigned to groups two groups: E (n = 20) mean age 61.6 (*SD* = 8.3), 44.4 (*SD* = 27.3) days since stroke; and C (*n* = 20) mean age 58.3 (*SD* = 12.9), 46.6 (*SD* = 26.2) days since stroke. | *I* = 20, 45 minute sessions for 5 days a week for 4 weeks. Group E received electrical stimulation of their left hand along with conventional visuo-spatial scanning training (consisting of saccadic training and attention and concentration training). Group C only received visuo-spatial scanning training combined with a sham stimulation.<br><br>*O* = hemineglect severity was determined through a Line and Star Cancelation Test, Behavioral Inattention Test, and by reading letters aloud. | Group E had more significantly increased scanning range than Group C ($U = 106.5$, $p = .01$). The change in score for scanning accuracy from baseline to post treatment was much greater in Group E (56.9) vs. Group C (27.2). The authors conclude that the TENS combined with scanning was a more effective treatment for the rehabilitation of hemineglect thank scanning training alone. | Modest sample size, with single therapist; no follow up; confounding factor of joint effect e-stim and cognitive training. |
| Schröder, Wist, & Hömberg (2008) | Compare three therapy outcomes of (1) ET with addition of (2) TENS or addition of (3) OKS | Randomized Controlled Trial<br><br>Pyramid Evidence Level = E2<br><br>AOTA Evidence Level = I | *N* =30 participants >90 days since stroke; left neglect moderate severity; right-handed. Group 1: 7 men, 3 women; mean age 68.4 (*SD* = 7), mean time 43.8 days since stroke. Group 2: 5 men, 5 women; mean age 60.6 (*SD* = 14.3), | *I* = (20) 20-45min sessions over 4 weeks; 3 groups: (1) ET; (2) ET + TENS; (3) ET + OKS.<br><br>*O*= Measures: Hemineglect using NTs, everyday-relevant measures of reading | TENS and OKS groups showed statistically significant improvements in outcomes over ET alone NTs: TENS ($p < 0.005$), OKS ($p < 0.004$); Reading writing: TENS ($p < 0.001$) OKS ($p < 0.001$), no difference between TENS and | Session times varied, does not describe which participants received increased duration of treatment. |

| | | | | | | |
|---|---|---|---|---|---|---|
| | | | mean time 24.6 days since stroke. Group 3: 6 men, 4 women; mean age 67.3 (*SD* = 9.1), mean time 36.2 days since stroke. | | OKS (NS). Stable at 1-week follow up. These results show that both TENS and OKS in combination with exploration training are superior to exploration training alone, thus both methods can be recommended. | |
| Seniów, Polanowska, Leśniak, & Czlonkowska (2015) | Examine the effect of e-stim on left hand during early VST rehabilitation of post-stroke patients with hemispatial neglect. | Double-blind Randomized, controlled Trial<br><br>Pyramid Evidence Level = E2<br><br>AOTA Evidence Level = I | *N* = 29, participants with R CVA, moderate to severe left-neglect; Experimental (E) *n* = 14; 7 male, 7 female; mean age 63.4 (*SD* =7.7); median time since stroke 40.5 days (25-140), Control (C ) *n* = 15) 8 male, 7 female; mean age 60.2 (*SD* = 9); median time since stroke 35.5 days (27-45). Exclusion: prior brain damage; neurological or psychiatric illness; impaired visual perception; medication affecting cortical | *I* = (E) VST + TENS; (C) VST + sham. 3wk, 15 sessions (5/week) 45 min of VST, with first 30 min either TENS or sham added. VST included saccadic training and attention and concentration exercises.<br><br>*O* = Severity of neglect measure by BIT. | No adverse effects of TENS were observed. All patients improved significantly between pre-treatment and post-treatment on BIT scores, ($t(28) = -8.53$, $P = 0.001$). BIT scores did not differ significantly between E and C groups ($F(1, 22) = 0.294$, $P = 0.593$. The findings suggest that TENS failed to enhance the tx effect of VST. | Did not use varied frequencies of TENS, only low; no functional measures were performed; modest sample size. |

| | | | | | | |
|---|---|---|---|---|---|---|
| | | | excitability; contraindications to e-stim. | | | |

| Mirror Therapy – Quantitative: experimental studies | | | | | | |
|---|---|---|---|---|---|---|
| **Author, Year** | **Study Objectives** | **Study Design/ Level of Evidence** | **Participants: Sample Size, Description Inclusion and Exclusion Criteria** | **Interventions & Outcome Measures** | **Summary of Results** | **Study Limitations** |
| Dohle, MPhil, Pullen, Nakaten, Kust, Rietz & Karbe, (2009) | Evaluate effects of Mirror Therapy on UE movement, pain, sensation and attention post CVA. | Randomized Controlled Trial<br><br>Pyramid Evidence Level = E2<br><br>AOTA Evidence Level = I | *N* = 36, <8wks post CVA (mean = 27.8 days). Randomized to MT or CT. Inclusion: Mean age of participant = 56 yrs Inclusion: All participants with 1st ever MCA CVA, able to sit upright, follow instructions and tolerate 30 min therapy sessions. | *I* = MT was bilateral movements looking at reflection of less affected UE. CT same movements but w/o mirror so BUE visible to pt. All 30min/day, 5day/wk for 6 weeks.<br><br>*O* = BI, & TAP | 9 in CT and 11 in MT tested positive for neglect. Those in the MT group improved significantly more than CT group ($F$ = 10.4, $p$ = 0.005, effect size = 0.99). Authors conclude that MT is promising for both sensory and attentional deficits. | Rating of neglect (combination of 2 outcomes) devised by authors so validity not tested. Modest sample size (20 w/ neglect). No follow up beyond 6 weeks. |
| Tyson, Wilkinson, Thomas, Selles, McCabe, Tyrrell, & Vail, 2015 | Feasibility trial for patient led tx (either MT or lower limb exercises) in acute setting. | Randomized Controlled Trial<br><br>Pyramid Evidence Level = E2<br><br>AOTA Evidence Level = I | Mean age = 64, mean time post CVA = 28.8 days. Recruited from 12 hospitals. Randomized to MT (UE only) (N = 62) or lower limb exercises (N = 31) using strata of upper limb weakness and presence of neglect. Each group acted as the | *I* = Individualized to pt. Tx moved up through levels of complexity from simple flex/ext with limb supported to more goal directed activity (grasp and move or stand and sit). 30 min/day for 4 weeks. 30 min need not be consecutive.<br><br>O = SCT. Assessed at baseline, end of 4 wk tx and 8 wk follow up. | Neglect score were improved in MT group but difference was not significant (4 weeks $P$ = 0.3, 8 weeks $P$ = .24). There were no adverse events. Conclusion is that MT can be used by patients in self-directed way to increase overall time spent practicing therapeutic | Pt self-reported their minutes. If nothing recorded could be exercise was not done or only not recorded. MT group twice the size of lower limb exercise group. Number of participants with neglect not reported. As a result, study may be under powered. |

| | | | | | | |
|---|---|---|---|---|---|---|
| | | | control for the other. Inclusion: UE and LE limitations due to CVA occurring > 1 week prior. | | activities. Both groups did exercises for less duration and freq than recommended. | |
| Thieme, Bayn, Wurg, Zange, Pohl & Behrens, (2012) | Evaluate effects of MT on sensorimotor function, ADLs, QOL, and Visuospatial neglect on pt post CVA. Investigate if MT is as effective in group setting vs individual tx. | Randomized Controlled Trial<br><br>Pyramid Evidence Level = E2<br><br>AOTA Evidence Level = I | *N*=60, <3mo post CVA. Randomized to individual tx, group tx or CT group. After tx only 49 assessed, others discharged, died or withdrew for unspecified reasons. Mean age of participant = 67 yrs. Exclusion: neglect too severe to follow directions to turn head towards mirror on left. | *I* = Individual or group MT, bilateral mvts looking at reflection of less affected UE. CT same mvt but viewing unaffected, view of affected blocked. All 30min/day, 20 sessions over 5wks.<br><br>*O* = Star Cancellation Test. | Individual MT had group interaction ($F$=7.5, $p$=0.009) post hoc revealed significant improvement compared to control group ($p < 0.01$). Group MT was not significantly different that other tx groups. No difference in other (non-neglect) outcomes for group vs individual tx. Conclusion: Individual but not group MT is effective for neglect. | No long-term follow up. Small neglect sample size (N = 14). Design not focused on neglect. Assessors not blind to tx. Low dosage of tx compared to other studies. |

| | | | | | | |
|---|---|---|---|---|---|---|
| Pandian, Arora, Kaur, Sharma, Vishwambaran, & Arima, (2014) | Evaluate the effects of Mirror Therapy on unilateral neglect post CVA. | Randomized Controlled Trial<br><br>Pyramid Evidence Level = E2<br><br>AOTA Evidence Level = I | *N*=48, <48 hours post CVA. Randomized to MT or CT. Mean age of participant = 63 yrs. All participants with parietal or thalamic lesions. Exclusion: Glasgow score <7 or were deemed uncooperative. | *I* = MT – bilateral mvts looking at reflection of less affected UE. CT- same mvts viewing unaffected, view of affected blocked. Both 1-2hr/day, 5 day/wk, 4 wks.<br><br>*O* = SCT, LBT, & PIT assessed at 1, 3 and 6 months. | MT group improved significantly more than CT by all outcome measures and at each follow up assessment. Analysis of covariance range of *p* value was between $p < 0.0001$ (SCT & PIT all follow up assessments) and $p = 0.006$ (LBT at 6 mo). | Differences in lesions, manual dexterity, and stage of recovery between control and treatment groups not clear. "Uncooperative" in exclusion criteria not explained. |

| **Limb Activation Therapy – Quantitative: experimental studies** | | | | | | |
|---|---|---|---|---|---|---|
| **Author, Year** | **Study Objectives** | **Study Design/ Level of Evidence** | **Participants: Sample Size, Description Inclusion and Exclusion Criteria** | **Interventions & Outcome Measures** | **Summary of Results** | **Study Limitations** |
| Fong, Yang, Chan, Chan, Lau, Chan, Cheung, Cheung, Chung, & Chan (2013) | Compare effects of contralesional sensory cueing and limb activation with sham control in tx of unilateral neglect post-CVA | Randomized controlled trial. pilot study. Pyramid Evidence Level = E2 AOTA Evidence Level = I | *N*=40, experimental group *n*=19, control group *n*=16, Inclusion: R CVA, unilateral neglect; 51-81 y/o, 5-43 days post-CVA, pts in 2 rehab hospitals, severe to moderate unilateral upper limb paresis w/ beginning voluntary movement Exclusion: significant impairment in visual acuity | *I*= 3 hrs/day, 5 days/wk, 3 weeks. Experimental: conventional rehab w/ wristwatch cueing device, asked to actively move their upper limb to press button when given vibration and/or beeping cue from wristwatch and move 5x in elbow flex/ext or shldr flex/abd depending on motor control. Control: wore sham device, same tx w/o sensory cueing function. *O*= scores on BIT, cancellation and drawing tasks, FIM, FTHUE, FMA upper limb and hand subtests | No significant differences between groups except in the BIT drawing tasks where experimental group showed higher scores than the sham group ($p$=.03). Significant improvement of arm movement for experimental group on FMA tests. Results inconclusive for LAT and sensory cueing on improvement of neglect. | 5 participants dropped out of study w/ total *N*=35 and uneven groups. Spontaneous recovery may have contributed to improvement. Sham device could have provided cueing to increase awareness. |
| Maddicks, Marzillier, & Parker, (2003) | Effectiveness of LAT on unilateral neglect in 3 spatial domains (personal, peripersonal, locomotor) at an | Single Subject Study, ABABA design | *N*=1, 8 wks post-CVA, 55 y/o male, R CVA, showed neglect on 2 subtests of Behavioral Inattention Test and | *I*= traditional treatment with and without active lower limb activation. External buzzer used to cue. Participant turned buzzer off w/ LLE. 5 phases w/ 5 assessment | No significant effect of 2 phases of LAT on tasks in any of 3 spatial domains. There was a significant effect of 1st tx | Limited sample size, spontaneous recovery and tx carry-over may have contributed to improvement on certain tasks, |

| | | | | | | |
|---|---|---|---|---|---|---|
| | acute stage of recovery | Pyramid Evidence Level = E4<br><br>AOTA Evidence Level = III | on everyday activities, L-sided hemianopia, minimal active movement in LUE. Inclusion/Exclusion criteria not reported. | days each (baseline, LAT, no tx, LAT, follow-up) *O*= scores on CBS (assess unilateral neglect in 10 areas of daily life in rehab setting), scores on tasks assessing ability in 3 spatial domains, Beard Trimming Task (personal, shave beard on face), Coin Task (peripersonal, arrange coins evenly), Shapes Task (locomotor, name shapes on wall) | phase on tasks in peripersonal and locomotor space and effect may have carried over into following phases. Subject showed no evidence of neglect in personal space from beginning of study, so no conclusions can be drawn from data. No improvement on CBS | L-sided hemianopia may have led to worse scores. Lower limb activation used because unable to activate w/ upper limb which may have led to uncertain outcomes. No stable baseline. |
| Pitteri, Arcara, Passarini, Meneghello, & Priftis, (2013) | Evaluated effects of LAT alone and in combination with CAV on LN | ABAB single subject study<br><br>Pyramid Evidence Level = E4<br>AOTA Evidence Level = IV | *N* = 1, 44-yo male, 63 days s/p left CVA and approx 3 months s/p right CVA: severe LN. Inclusion/Exclusion criteria not reported. | *I* = (10) 1 hr ABAB blocks, 5 days/wk for 8 weeks. A: LAT; B: LAT + CAV.<br><br>*O* = Measures: Hemineglect using Bells test, Picture Scanning test, Line Bisection test. | Improvement in Bells test with combined LAT and CAV (*C* = 0.46, *Z* = 1.97, *p* < 0.05; LAT + CAV/1 mean = 26.2, LAT/2 mean = 20.8) no significant effects on others. Positive results of this preliminary study suggest the need for more extensive research on combined rehabilitation treatments. | Reliable assessment difficult due to high intra-individual variability in performance; lack of repeated measures on baseline; difficult to determine if training with assessment occurred; limited generalizability due to single subject. |

| | | | | | | |
|---|---|---|---|---|---|---|
| Robertson, McMillan, MacLeod, Edgeworth, & Brock, (2002). | Hypothesis: LAT will produce lasting reductions in unilateral neglect and improvement in contralesional motor function | Randomized Controlled Trial<br>Pyramid Evidence Level = E2<br>AOTA Evidence Level = I | *N*=40, Experimental Group *N*= 19, Control Group N= 21, 4 dropped out, Inclusion: R CVA w/ L neglect defined by BIT SCT or LBT, treatment in patient's homes or SNF, mean Motricity Index = 52.4<br>Exclusion: psychiatric problems, co-existing disease/disability | *I*= 12 sessions, 45 mins, 12 weeks. Follow-up 6 months and 18-24 months. Experimental: perceptual training (PT) plus LAT training. Control: PT alone. PT= worksheets, reading, writing, cognitive exercises, cueing to attend to L side. LAT= LAD attached to L wrist which emits tone if a movement is not made within a set period of time, limb must be moved to turn it off, verbal cueing from therapist if needed. 7 subjects required LAD to be attached to L shoulder or L leg because they didn't have sufficient movement of L arm.<br>*O*= Scores on BIT, Comb and Razor Test, Landmark Test, CB rating scale of unilateral neglect | ANCOVA performed on each outcome measure. None of the outcome measures for neglect showed statistically significant time by treatment condition interactions. However, outcome measures for motor function of the contralesional side were statistically significant (*p*=.009). | LAT treatment focused on motor involvement instead of neglect so difficult to measure outcomes for neglect, patients received consistent feedback in each group, only 45 mins a week, other therapy could have interfered with results. Lower leg activation may have led to worse outcomes. |

| **Limb Activation Therapy – Quantitative: outcome studies** | | | | | | |
|---|---|---|---|---|---|---|
| **Author, year** | **Study Objectives** | **Study Design/ Level of Evidence** | **Participants: Sample Size, Description inclusion exclusion criteria** | **Interventions & Outcome Measures** | **Summary of Results** | **Study Limitations** |
| Eskes, Butler, McDonald, & Harrison, (2003) | Assess the efficacy of passive and active limb movement to improve visual scanning in patients with hemi-spatial neglect | Single group pre-post study, Pyramid Evidence Level = O4 AOTA Evidence Level = III | *N*=9, R CVA w/ L side neglect, both inpatient and outpatient at tertiary care hospital, ranged 2 wks to 13 yrs post-CVA, all pts had motor, sensory, and visual field deficit, 3 pts had enough motor function to participate in both FES-stim movement and active movement conditions. Exclusion criteria not reported. | *I*= 10 trials each, 1-2 day period. No movement (sit w/ hands in lap), active movement (press mouse switch 2x w/ L hand), passive movement (FES stimulation to L hand) *O*= (outcomes done during each condition) percentage of correctly identified targets on visual scanning task for L and R sides, Sunnybrook Bedside Neglect Battery, Cognistat, digit span test | Significant increase in percentage of correct targets (*n*=8, 17.8%, $p<.05$) on L side during passive movement compared to no movement. Increase during active movement in 2 of 3 participants, only 1 was statistically significant (n=1, 20%, $p<.01$). Authors suggest that FES-stimulated passive movement and active movement are of potential therapeutic benefit in improving visual scanning and leftward attention in pts w/ neglect. | Small sample size, only 3 of 9 participants had enough limb function for active movement condition so direct comparison of passive vs. active is difficult. Sensory input of FES could interfere w/ results. Did not differentiate if increase in active movement was compared to no movement or passive movement. |

| | | | | | | |
|---|---|---|---|---|---|---|
| Reinhart, Schmidt, Kuhn, Rosenthal, Schenk, Keller, & Kerkhoff, (2012) | Examine whether limb activation or alertness cueing can modulate disturbed body schema of patients w/ personal neglect | Single group pre-post study, Pyramid Evidence Level = O4 AOTA Evidence Level = III | *N*=8, R CVA w/ L sided spatial neglect, mean age = 61.1 yrs, mean time post-CVA = 9.8 wks, motor control requirements not reported. Exclusion criteria not reported. | *I*= 2 sessions, 1 hour each, 1 week period. Conditions implemented in randomized order, passive limb activation (continuous stretch and flex by examiner during test, began 5 mins prior to test), alertness cueing (presented over loud speaker before every visual stimulus) *O*= Hand Test, recognition and discrimination of schematic drawings of R and L hands. Visual neglect tests (paragraph reading, horizontal line-bisection, number cancellation, drawing figures) before 1st session and after 2nd session. | Significant reduction in decision errors for limb activation, but not for alertness cueing on L side. Significant difference between treatments (*d*=.91, *p*=.03). No significant difference in L and R hand recognition (*p*=.06). Authors conclude LAT possibly has advantage over alertness cueing in manipulating the disturbed identification of left hands in patients w/ neglect. | Limited sample size, no non-neglecting control group included, immediate effects measured only, cumulative effects may have impacted results. |

| Meta-Analysis/Meta-Syntheses/Systematic Review Evidence | | | | | | |
|---|---|---|---|---|---|---|
| **Author, Year** | **Study Objectives** | **Study Design/ Level of Evidence** | **Number of Papers Included, Inclusion and Exclusion Criteria** | **Interventions & Outcome Measures** | **Summary of Results** | **Study Limitations** |
| Gillen, Nilsen, Attridge, Banakos, Morgan, Winterbottom, & York, 2015 | To summarize the evidence for effectiveness of various treatments for cognitive and perceptual impairments post CVA on occupational performance. | terary<br>ystematic Revie<br><br>yramid<br>vidence<br>evel = E1<br><br>AOTA<br>vidence<br>evel = 1 | 6 articles (27 level I, 9 evel II, and 10 level II). At least one outcome neasuring occupational erformance. | *I* = for USN were Prisms, VST, MT, Eye Patching, Neck Muscle Vibration, Family involvement in therapy, and spatial cuing and LAT.<br>*O* = FIM, reading, w/c mobility, BIT, lower body dressing, bathing. | VST: Good evidence from level I and II studies.<br>MT: Insufficient (2 studies, small sample sizes). EP: Mixed. Family participation: positive but insufficient (small sample size). LAT: Insufficient (1 study, small sample size). More and larger studies are needed for all interventions. | Literary review with no calculations of effect size. For some interventions the inclusion criteria meant very few studies could be included. Many studies had small sample sizes and inconclusive evidence. Review includes impairments other than USN and some articles included examined both CVA and TBI. The authors are not clear about which studies these were. |

| | | | | | | |
|---|---|---|---|---|---|---|
| Jutai, Bhogal, Foley, Bayley, Teasell, & Speechley (2003) | To evaluate effectiveness of interventions used to treat unilateral neglect. | Systematic Review<br><br>Pyramid Evidence Level = E1<br><br>AOTA Evidence Level = 1 | *N* = 32 RCT studies were included that covered individuals with acute stroke and traumatic brain injuries who were experiencing visual perceptual deficits. Time since stroke was not specified. | *I* = VST, activation treatments, PA, eye patching, MT, caloric stim, computer-based rehab, general tx, TENS, and Dopaminergic medication. PEDro score used to rate RCTs. *O* = Barthel index, Rivermead ADl Scale, Rivermead Motor assessment, Rey Figure Copy, FIM, Line bisection/line cancellation test, Bell test, BIT, WAIS-R, Neale Reading Test, and more as listed in the article. | The treatment of unilateral neglect with VST and other specialized treatments does not transfer to function/remediation in mobility and ADL. Moderate evidence for eye patching and PA. Strong evidence for VST. Limited evidence for TENS and Dopaminergic medication. Conflicting evidence for activation strategies. | Avoidance of bias in study selection unclear.<br><br>This article only included RCTs.<br><br>The research results were not fully explained.<br><br>Search strategy not clearly identified. |

| | | | | | | |
|---|---|---|---|---|---|---|
| Klinke, Hafsteinsdottir, Hjaltason, Jonsdottir, 2015 | Identify interventions for USN that can be used in ward-based nursing. | Systematic Review<br><br>Pyramid Evidence Level = E1<br><br>AOTA Evidence Level = 1 | 41 articles (16 level II, 19 level III, and 6 level IV)<br>Included descriptive/case studies and experimental studies. Interventions had to be relatively simple and inexpensive to implement. | *I* = TENS, stimulus and reward, LAT, mental imagery, MT, music therapy, eye patching, eye mvt training, virtual reality, VST.<br>*O* = range of occupation-based and non occupation-based outcomes including FIM, BIT, reading, CBS, coin sorting. | Recommendations were graded. Some evidence in support of LAT but lacking follow up (grade C). MT significant improvement but small sample size and did not use functional outcome (grade C). VST some support from low level studies (grade D). TENS improvement seen but no evidence of lasting effect (grade C). | This review's focus was on interventions suitable for nursing staff to perform. May have excluded articles most relevant to OT intervention. |
| Lisa, Jughter, Kerckhofs, (2013) | To determine the effectiveness of treatments for patients with UNS post stroke. | Systematic Review<br><br>Pyramid Evidence Level = E1<br><br>AOTA Evidence Level = 1 | *N* = 22 RCTs reviewed<br>*N* = 15 RCTs selected. Included subacute or chronic stroke pts. 20-80 years of age. Only RCTs used. | Systematic review analyzing the effects of interventions addressing UNS by comparing statistical significance, effect size, and methodological quality of RCTs using the 9-item Delphi list. The outcome measures used in the majority of the reviewed RCTs were the BIT and the CBS. | Found that TENS (effect size = *d* >0.08), OKS (*d* > *0.80)* somatosensory e-stim (*d* > 0.08), MT (*d* > 0.80), and virtual reality training (*d* = >0.80) were most effective for treating UNS CVA. Combining interventions may be more effective than implementing a single one. | Quality of RCTs varied. The RCTs looking at TENS and OKS were low quality, virtual reality was moderate quality, and somatosensory e-stim and MT were good quality. RCT reporting on MT was of good quality, it was one of two studies that did not report effect size. Additionally, there was variability in the outcome |

| | | | | | | |
|---|---|---|---|---|---|---|
| | | | | | | measures that the RCTs used to collect data. A single outcome measure was not used across all studies. Majority of RCTs had small sample sizes, the largest being *N* = 20. |
| Luauté, Halligan, Rode, Rossetti, & Boisson (2006) | To evaluate the effectiveness of 17 interventions used to treat visuo-spatial neglect in pts. post stroke. | Systematic Review Pyramid Evidence Level = E1 AOTA Evidence Level = 1 | *N = 54* studies included. Inclusion criteria were pts. post right brain stroke with evidence of neglect, interventions addressing neglect, and studies that used functional outcome measures such as the BIT, CBS, BI, FIM, and AMPS. Patient ages and time since stroke not reported. | *I* = VST, LA, space remapping, mental imagery training, rTMS, sustained attention training, training at a functional level, feedback training, vestibular stimulation, OPK, Neck muscle vibration, trunk rotation, Fresnel prisms, eye patching, PA, music therapy, Dopamine-agonists, and noradrenergic agonist. Articles were assessed for quality with an adapted analytical grid from the evidence-based | VST + Trunk rotation, VST + neck muscle vibration, mental imagery training, video feedback training and PA showed the most evidence for effective treatment of visuo-spatial neglect. | No statistics were reported. The introduction discusses several interventions (with citations) but does not have any included research articles in the review, such as: space remapping, rTMS, OPK, trunk rotation, music therapy, and Noradrenergic agonist. It may have been beneficial to include citation tracking as well as |

| | | | | | | |
|---|---|---|---|---|---|---|
| | | | | medicine levels of evidence. | | the search strategy. Mirror therapy was addressed as feedback training. |
| Thieme, Mehrholz, Pohl, Behrens, Dohle, & MPhil, (2012) | Summarize evidence supporting effectiveness of MT for improving motor function, ADL, pain and neglect post CVA. | Accepted RCT and randomized crossover trials all Pyramid Evidence Level = E1 AOTA Evidence Level =I | *N* = 14 studies total. 8 databases searched, publication date of included articles = 1999 – 2011. Used Cochrane methodology. Inclusion = RCTs and crossover RCTs comparing MT to other tx or no tx. Pt with paresis of UE or LE due to CVA. | *I* = MT with or without other tx. O = Primary outcome = motor function. Used standardized mean differences to analyze results across studies. BIT and TAP | Found limited evidence that MT improves neglect (SMD 1.22; 95%CI 0.24-2.19; *P*=0.01). The effect of MT was stable 6 months post tx. | Evidence for MT use in neglect based on one study. Misleading title suggests only motor outcomes. |
| Ting, Pollock, Dutton, Doubal, Ting, Thompson, & Dhillon (2011) | The purpose of this systematic review was to provide information on the epidemiology, varieties of neglect, functional impact, pathophysiology, assessment of visual neglect, and rehabilitation. | Systematic Review<br><br>Pyramid Evidence Level = E1<br><br>AOTA Evidence Level = 1 | *N* = 8 systematic reviews included | *I* = VST, OPK, LA, cueing, neck muscle vibration, trunk rotation, caloric stimulation, eye patches, Fresnel prisms, sustained attention training, PA, environmental modification, pharmacological treatment, mental imagery, VR space remapping, rTMS, and | Promising interventions are VST, and PA. The consensus of the article is that further, high-quality, research must be done before any definitive recommendations can be made. | A clear search strategy was not reported. Only brief explanation provided. No inclusion/exclusion criteria specified. Did not identify quality of the studies. Discussed multiple topics but only performed a systematic review on interventions. |

| | | | | | | |
|---|---|---|---|---|---|---|
| | | | | music therapy. *O* = pencil-and-paper tests, BIT, and the CBS. | | |
| Yang, Zhou, Chung, Li-Tsang, Fong, (2013) | Assess effectiveness of rehabilitation and treatment for UN via the BIT | Systematic review of RCTs on interventions for UN in adult patients after stroke.<br><br>Pyramid Evidence Level = E1<br><br>AOTA Evidence Level = I | *N* = 201 RCTs reviewed<br>*N* = 12 RCTs selected<br>Total Participants = 277<br>1997 to 2012 | *I* = PA, rTMS, virtual reality, visuomotor feedback, limb activation, continuous Theta-burst stimulation, and a combination of trunk rotation and eye-patching. Only studies using the BIT scores as the primary outcome measure were included. Quality of trials evaluated using the PEDro scale, 8 studies evaluated as good, 4 studies as fair. Exclusion: observational studies, case-reports, cross-over designs, PEDro ratings 4/10 or less (poor), and those where full text was unavailable. | Modest evidence supports the effectiveness of PA to reduce UN in patients with stroke. BIT immediate score (ES = 0.76; 95% CI 0.28-1.23; $p$ = 0.0002), BIT total score (ES = 0.55; 95% CI 0.16-0.94; $p$ = 0.0006); rTMS may have promising results but further studies are needed. | Exclusionary criteria, primarily the BIT outcome measure, limited the review to 12 studies, only five of which were dedicated to the same intervention; in addition the studies reviewed had limitations indicated by the PEDro scores included blinding with both therapists and subjects, as well as the absence of intention to treat analysis. |

| VST | | | | | | | | | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Reference | Study Type | Quality Score | C. 1 | C. 2 | C. 3 | C. 4 | C. 5 | C. 6 | C. 7 | C. 8 | C. 9 | C. 10 | C. 11 | C. 12 | C. 13 | C. 14 | C. 15 | C. 16 | C. 17 | C. 18 | C. 19 | C. 20 |
| Bailey, et al., 2002 | Single-Subject | 15/20 | 1 | 1 | 0 | 1 | 1 | 1 | 1 | 0 | 1 | 1 | 0 | 1 | 0 | 1 | 1 | 1 | 1 | 1 | 0 | 1 |
| Ferreira, et al., 2011 | RCT | 4/10 | no | 0 | 0 | 1 | 0 | 0 | 0 | 1 | 0 | 1 | 1 | | | | | | | | | |
| Kerkhoff, et al., 2014 | RCT | 7/10 | no | 1 | 1 | 1 | 0 | 0 | 1 | 0 | 1 | 1 | 1 | | | | | | | | | |
| Kerkhoff, et al., 2013 | RCT | 7/10 | no | 1 | 1 | 1 | 0 | 0 | 0 | 1 | 1 | 1 | 1 | | | | | | | | | |
| Luukkainen et al., 2009 | RCT | 5/10 | yes | 1 | 1 | 1 | 0 | 0 | 0 | 1 | 0 | 0 | 1 | | | | | | | | | |
| Piccardi, et al., 2006 | One group pre/post | 5/12 | 1 | 0 | 0 | 0 | 0 | 1 | 1 | 0 | 1 | 1 | 0 | 0 | | | | | | | | |
| van Wyk, et al., 2014 | RCT | 5/10 | yes | 0 | 0 | 1 | 0 | 0 | 1 | 1 | 0 | 1 | 1 | | | | | | | | | |
| TENS | | | | | | | | | | | | | | | | | | | | | | |
| Reference | Study Type | Quality Score | C. 1 | C. 2 | C. 3 | C. 4 | C. 5 | C. 6 | C. 7 | C. 8 | C. 9 | C. 10 | C. 11 | C. 12 | C. 13 | C. 14 | C. 15 | C. 16 | C. 17 | C. 18 | C. 19 | C. 20 |
| Guariglia, et al., 2000 | Clinical Trial | 3/10 | no | 0 | 0 | 0 | 0 | 0 | 0 | 1 | 1 | 1 | 0 | | | | | | | | | |
| Lafosse, et al., 2003 | Clinical Trial | 5/10 | yes | 0 | 0 | 1 | 0 | 0 | 0 | 1 | 1 | 1 | 1 | | | | | | | | | |
| Perennou, et al., 2001 | Clinical Trial | 5/10 | yes | 0 | 0 | 1 | 0 | 0 | 0 | 1 | 1 | 1 | 1 | | | | | | | | | |
| Polanowska, et al., 2009 | RCT | 7/10 | (PEDro score given) | | | | | | | | | | | | | | | | | | | |
| Seniow, et al., 2015 | RCT | 8/10 | yes | 1 | 0 | 1 | 1 | 1 | 0 | 1 | 1 | 1 | 1 | | | | | | | | | |
| Schroder, et al., 2008 | RCT | 4/10 | (PEDro score given) | | | | | | | | | | | | | | | | | | | |
| Mirror Therapy | | | | | | | | | | | | | | | | | | | | | | |
| Reference | Study Type | Quality Score | C. 1 | C. 2 | C. 3 | C. 4 | C. 5 | C. 6 | C. 7 | C. 8 | C. 9 | C. 10 | C. 11 | C. 12 | C. 13 | C. 14 | C. 15 | C. 16 | C. 17 | C. 18 | C. 19 | C. 20 |
| Dohle, et al., 2009 | RCT | 8/10 | yes | 1 | 1 | 1 | 1 | 0 | 1 | 0 | 1 | 1 | 1 | | | | | | | | | |
| Pandian, et al., 2014 | RCT | 5/10 | yes | 1 | 0 | 1 | 0 | 0 | 1 | 1 | 0 | 1 | 0 | | | | | | | | | |
| Thieme, et al., 2012 | RCT | 6/10 | yes | 1 | 1 | 1 | 0 | 0 | 0 | 0 | 1 | 1 | 1 | | | | | | | | | |
| Tyson, et al., 2015 | RCT | 8/10 | yes | 1 | 1 | 1 | 0 | 0 | 1 | 1 | 1 | 1 | 1 | | | | | | | | | |
| Limb Activation | | | | | | | | | | | | | | | | | | | | | | |
| Reference | Study Type | Quality Score | C. 1 | C. 2 | C. 3 | C. 4 | C. 5 | C. 6 | C. 7 | C. 8 | C. 9 | C. 10 | C. 11 | C. 12 | C. 13 | C. 14 | C. 15 | C. 16 | C. 17 | C. 18 | C. 19 | C. 20 |
| Eskes, et al., 2003 | One group pre/post | 5/11 | 1 | 0 | 1 | 0 | 0 | 1 | 1 | 0 | 0 | 1 | 0 | NA | | | | | | | | |
| Fong, et al., 2013 | RCT | 6/10 | yes | 1 | 1 | 0 | 0 | 0 | 0 | 1 | 1 | 1 | 1 | | | | | | | | | |
| Maddicks, et al., 2003 | Single Subject | 12/20 | 1 | 0 | 0 | 1 | 1 | 1 | 1 | 0 | 1 | 1 | 0 | 1 | 1 | 1 | 1 | 0 | 1 | 0 | 0 | 0 |
| Pitteri, et al., 2013 | Single Subject | 12/20 | 1 | 0 | 0 | 1 | 1 | 1 | 1 | 0 | 1 | 1 | 0 | 1 | 0 | 1 | 1 | 0 | 1 | 0 | 0 | 1 |
| Reinhart, et al., 2013 | One group pre/post | 5/11 | 1 | 0 | 1 | 0 | 0 | 1 | 1 | 0 | 0 | 1 | 0 | NA | | | | | | | | |
| Robertson, et al., 2002 | RCT | 6/10 | yes | 1 | 0 | 1 | 0 | 0 | 1 | 1 | 0 | 1 | 1 | | | | | | | | | |
| Systematic Reviews | | | | | | | | | | | | | | | | | | | | | | |
| Reference | Study Type | Quality Score | C. 1 | C. 2 | C. 3 | C. 4 | C. 5 | C. 6 | C. 7 | C. 8 | C. 9 | C. 10 | C. 11 | C. 12 | C. 13 | C. 14 | C. 15 | C. 16 | C. 17 | C. 18 | C. 19 | C. 20 |
| Gillen, et al., 2015 | Literary Systematic Review | n/a | | | | | | | | | | | | | | | | | | | | |
| Jutai, et al., 2003 | Systematic review | 4 | y | Y | N | ct | y | y | y | y | y | major | | | | | | | | | | |
| Klinke, et al., 2015 | Systematic review | 4 | y | Y | Y | y | y | y | n | p | y | major | | | | | | | | | | |
| Lisa, et al., 2013 | Systematic review | 7 | y | Y | Y | y | y | y | y | y | y | minimal | | | | | | | | | | |
| Luaute, et al., 2006 | Systematic review | 7 | y | Y | Y | y | y | y | y | y | y | minimal | | | | | | | | | | |
| Thieme, et al., 2012 | Cochrane Review | 7 | y | Y | Y | y | y | y | y | y | y | minimal | | | | | | | | | | |
| Ting, et al., 2011 | Literary Systematic Review | 4 | y | N | N | n | n | ct | y | y | y | major | | | | | | | | | | |
| Yang, et al., 2013 | Systematic review | 7 | y | Y | Y | y | y | y | y | y | y | minimal | | | | | | | | | | |

**Table 4: Quality ranking for all systematic reviews and research studies included in the CAT table. PEDro scores were calculated for all RCTs and clinical trials. Single subject studies were rated using the Quality Indicator Checklist: Single-Subject Studies. Systematic reviews were appraised using the "Guide to Appraising Systematic Reviews" in Law & MacDermid, 2014, pg 164-165. One group pre-post studies were appraised using the National Heart, Lung, and Blood Institute quality assessment tool available at: http://www.nhlbi.nih.gov/health-pro/guidelines/in-develop/cardiovascular-risk-reduction/tools/before-after.**

**Summary of Key Findings**

While visual scanning therapy (VST) has been the conventional therapy used for many years, it showed the least amount of improvement when compared to electrical stimulation, smooth pursuit eye movement training (SPT), and physiotherapy (Kerkhoff, et al., 2014; Kerkhoff, Reinhart, Zieglar, Artinger, Marquardt, & Keller, 2013; van Wyk, Eksteen, & Rheeder, 2014). In fact, the most compelling evidence came from 2 high quality RCTs (PEDro scores 7) that found SPT to be much more effective at relieving visual neglect symptoms than VST (Kerkhoff, et al., 2014; Kerkhoff, et al., 2013). However, VST has been shown to be equally as effective as limb activation training, although this evidence is of fair quality (PEDro 5, Quality Indicator Checklist 15/20) and inconclusive (Bailey, Riddoch, & Crome, 2002; Luukkainen, Tarkka, Pitkanene, Sivenius, & Hamalainen, 2009). When used by itself, VST proved to be more effective than task specific training, and no treatment, but did not transfer to other situations; thus, it is hypothesized to lack in generalizability (Polanowska, Seniów , Paprot, Lesniak, & Czlonkowska, 2009; Kerkhoff, et al., 2014; van Wyk, et al., 2014; Jutai, Bhogal, Foley, Bayley, Teasell, & Speechley, 2003).

In a recent randomized control trial, Seniów et. al., (2015) found that the addition of TENS did not increase the effectiveness of visual scanning therapy for symptoms of hemi-attention in patients who have sustained a stroke. In contrast, all other studies reviewed described evidence indicating that the use of TENS for treatment can contribute to positive outcomes such as greater postural control and visual field scanning of the neglected side. TENS, when combined with other therapies such as limb activation treatment and exploration training have resulted in significant improvements over traditional methods of exploration training alone (Schröder, Wist, & Hömberg, 2008).

Four randomized controlled trials of fair to high quality (PEDro scores 5-8) on mirror therapy found some improvement in neglect post treatment (Dohle, MPhil, Pullen, Nakaten, Kust, Rietz, & Karbe, 2009; Pandian, Arora, Kaur, Sharma, Vishwambaran, & Arima, 2014; Thieme, Bayn, Wurg, Zange, Pohl, & Behrens, 2012; Tyson, Wilkinson, Thomas, Selles, McCabe, Tyrrell, & Vail, 2015). In these studies, MT was implemented between 48 hrs and 4 months post CVA and while there was no consensus on the best treatment protocol, treatment schedules were generally 30 minutes - 1 hour/day, 5 days/week and lasting 4-5 weeks. In all studies, improvement in neglect symptoms was present and attributable to MT when compared to the control group. Only one study (Pandian et al., 2014) provided follow up data for a period of time significantly post treatment (6 months) and found that improvements were still stable. Further research is needed to identify the most effective protocols and dosage, and should include follow up assessment.

Limb activation therapy (LAT) can be effective in increasing scanning techniques and awareness of individuals with hemi-neglect (Eskes, Butler, McDonald, & Harrison, 2003; Reinhart, et al., 2012; Fong, et al., 2013). However, LAT did not improve results for a patient in the acute phase of recovery at 8 weeks post-CVA (Maddicks, Marzillier, & Parker, 2003). The evidence is inconclusive and further research is needed to know the effectiveness of LAT as well as if it is beneficial on its own or when combined with other therapies.

No descriptive or qualitative studies that met inclusion criteria were found.

Finally, 5 systematic reviews, 2 meta-analyses, and 1 Cochrane review, all of fair to high quality (NHLBI scores of 4 and 7), found similar results as reported above. Findings support that VST and other specialized treatments (those included in this review and more that were not reviewed on the basis of exclusion criteria) lack generalizability to functional tasks and

occupations (Jutai et al., 2003). However, there is conflicting evidence reported for the use of TENS, and MT (Jutai et al., 2003; Thieme, Mehrholz, Pohl, Behrens, Dohle, & MPhil, 2012). Additionally, they found that combined interventions were often more effective than one, specifically when utilizing TENS, and/or VST (Lisa, Jughters, Keckhofs, 2013; Luate, Halligan, Rode, Rossetti, & Boisson, 2006). These reviews also state prism adaptation as a promising adaptation that should be researched further (Ting, Pollock, Dutton, Doubal, Ting, Thompson, & Dhillon, 2011, Yang, Zhou, Chung, Li-Tsang, & Fong, 2013).

**Implications for Consumers**

Stroke survivors with symptoms of hemi-inattention may experience improvements in their symptoms using a variety of interventions including VST, MT, TENS and LAT. While VST and LAT are therapist led and clinic based, MT and TENS are therapies that, once a program has been established, can be done at home easily and inexpensively and are shown to augment the clinic-based therapies. TENS units are readily available and there are many options for under $30. However, use of a TENS unit is contra-indicated for patients with pacemakers. Mirror boxes are simple and inexpensive ($20) to make. One study of MT found that improvements following treatment were maintained 6 months later (Pandian et al., 2014) but there is a general lack of follow up to establish long-term effects of all four interventions.

**Implications for Practitioners**

Each of the intervention strategies investigated have evidence of effectiveness in treating unilateral neglect post CVA, and as shown in table 5, each can be feasibly implemented in the inpatient rehabilitation setting. In their systematic review, Lisa, Jugherters, & Kerckhofs (2013) explain that while visual scanning and exploration training are the most widely used and best known methods of intervention, recent research has shown that “other treatment modalities can

achieve better results" (p. 618). Burgeoning evidence indicates the efficacy of combined interventions including TENS, mirror therapy, and limb activation coupled with traditional therapies to reduce the symptoms of hemi-inattention. Each of these treatments can be employed in an inpatient setting with little to no cost, additional time, or extensive trainings and therapists can train patients, family members and caregivers to utilize these methods at home.

Due to the lack of awareness seen in many patients in the early stages of recovery a bottom-up approach is indicated to "alter the disturbed brain representation of spatial attention by delivering asymmetrical sensory stimulation" (Seniów, et al., 2015, p. 2). Much of the current data suggest that attention and/or stimulation to the affected limb should increase "cortical excitation in the lesion vicinity" thereby "reducing hyperactivity in the intact cortex" resulting in an "amelioration of visual hemineglect symptoms" (Polanowska, et al., 2008, p. 378). Researchers go on to caution, however, that any stimulation therapies should be employed only when the patient's health has become stable due to the negative correlation between hyperactivation of the intact hemisphere and indicators of functional improvement (Polanowska, et al., 2008).

**Implications for Researchers**

At this point in the literature review, the evidence suggests that further research is needed to determine the most effective treatment for hemi-inattention. The current reviewed studies leave a few gaps in the research such as if TENS is an effective treatment on its own, if VST is a transferrable strategy, the protocols and dosage for MT, and the effectiveness of LAT in the acute stage of recovery. There are also many studies with sample sizes too small to make conclusive statements or generalize to the wider population. There is inconclusive evidence about what therapies should be combined to create the best client outcomes. Researchers may

also want to consider both the type (personal, peripersonal, extrapersonal, motor, perceptual, motivational) and severity of hemi-inattention symptoms when assessing the effectiveness of these or other interventions. It may be important to conduct research on whether improvement in neglect symptoms in one setting are transferable to other settings and other types of neglect. VST, in particular, is known to be effective within the setting where training has occurred and it would be valuable to look at the transferability of scanning skills following training that includes a systematic method to promote generalizability such as the multi-context approach (Toglia 1991). Effect of intervention will also be influenced by degree of anosognosia and should be considered when testing interventions. Answering these questions will lead therapists to determine the most effective interventions for treating hemi-inattention and improve evidence-based practice.

**Implications for Best Practice**

It is the responsibility of practitioners to provide best practice. Based on this preliminary review, it is recommended that practitioners not simply revert to using VST, but employ a combination of strategies that have been shown to be effective in the treatment of hemi-inattention in patients post CVA. Analysis of these articles would suggest that TENS, LAT, and MT in conjunction with VST show promising results for the remediation and/or compensation of hemi-inattention (Kerkhoff et. al., 2014; Lisa, et al., 2013; Polanowska et al., 2009; Schröder, et al., 2008; van Wyk, et. al., 2014). However, it must be understood that research on TENS, LAT, and MT is conflicted and these treatments should be employed cautiously until further research can be done to determine the most effective, feasible, and pragmatic treatment for hemi-inattention (Jutai et al., 2003; Thieme, Mehrholz, Pohl, Behrens, Dohle, & MPhil, 2012). Finally, there are other treatment modalities, such as prism adaptation, that show promise for effective

treatment. Clinicians should explore more research to determine if other treatments would be effective for their practice.

Table 5: Summary of the feasibility of Visual Scanning Therapy, Transcutaneous Electrical Nerve Stimulation (TENS), Mirror Therapy, and Limb Activation Therapy. Four aspects of feasibility are considered; cost-effectiveness, dosage and frequency of treatment, ease of implementation, and adverse effects.

| Criterion | VST | TENS | Mirror Therapy | Limb Activation |
|---|---|---|---|---|
| Cost-Effectiveness | VST is advantageous because it is low cost (Ferreira, Lopes, Luiz, Cardoso, & Andre, 2011) | TENS units are readily available online: http://www.amazon.com and http://www.discountmedicalsupplies.com starting at $18 for a home system. | Inexpensive to construct using readily available materials. Mirror tiles available for $10/6 tiles at Home Depot. YouTube video demonstrates construction of a mirror box. https://www.youtube.com/watch?v=gHFOkVakRkw Fully constructed mirror boxes range $65 - $80. Accepted as a low cost and simple to use intervention (Maxton, Dineen, Padamsey, & Munshi, 2013) | No cost to activate/move limb during treatment either by patient or therapist. Low cost if using an external device to cue movement, such as a timer. In this case, LAT added only the cost of wrist watch cueing device (Robertson, McMillan, MacLeod, Edgeworth, & Brock, 2002). Smooth pursuit eye movement therapy (SPT) and VST can use technology like the Dynavision which adds significant extra cost (Kerkhoff, Reinhart, Ziegler, Artinger, Marquardt, & Keller, 2013). A quote can be requested at http://www.dynavisioninternational.com/ |
| Training required | No additional training, outside of licensing, is required to administer VST. | No additional training is required, but therapist should use caution with patients who have body neglect and/or decreased sensation. Patient and caregiver education for HEP is recommended. | Therapist must understand the intention of the mirror and not compromise the illusion. Patients can self-administer once a therapeutic program has been developed. | LAT training added no extra time to existing training (Robertson, McMillan, MacLeod, Edgeworth, & Brock, 2002) |
| Dosage & Frequency | Requires less treatment time, 10 hrs, than other interventions (Ferreira, et al., 2011). A 5-week VST plan may improve symptoms from hemi-inattention and also increase functional participation, Ferreira, et. al. found that the benefits from VST were maintained at a follow up measurement 3 months later in 2011. | Dosage and frequency varied by study, (e.g., task duration of a few minutes to 30min/day, 5day/wk); appropriate to couple with other interventions or activities. Strength of frequency is sufficient at sub-threshold levels for activation of specific cortical areas (Polanowska, et. al., 2008). | No consensus on exact dosage and frequency. Positive effects were found with programs lasting 4-5 weeks with tx 30min-1 hour per day, 5 days per week (Dohle et al, 2009, Pandian et al, 2014). | No consensus on exact dosage and frequency. |

| | | | | |
|---|---|---|---|---|
| Ease of implementation | VST is easy to administer and does not require excess training or materials (Ting, Pollock, Dutton, Doubal, Ting, Thompson, & Dhillon, 2011). It also was received well by the participants and actually increased their motivation to participate in therapy as they saw results emerge (Ferreira, et al., 2011). | The unit is small, lightweight and portable; electrodes are easy to apply and remove. Most often used on UE, shoulder, or neck on hemi neglected side. | Easy to use, however, illusion does not work for all patients. If patient does not see illusion, then treatment will not be useful for them. | Easy to implement. May require external cueing by therapist or device. |
| Adverse effects | No adverse effects were reported. | TENS is a safe and well-established procedure that can be used in rehabilitation and home settings (Perennou, et. al., 2001). No adverse effects were reported; caution recommended for patients who have impaired sensation to prevent injury (Seniow, et al., (2015). Contraindicated for patients with pacemaker or seizure disorder. | No adverse effects are reported. Some caution advised with regard to possible fatigue due to required ability to focus attention on the mirror for a relatively long period of time (Klinke, Hafsteinsbottir, Hjaltson, & Jonsdottir, 2015). | No adverse effects are reported. |

| Abbreviations Key | |
|---|---|
| AVLT | Auditory Verbal Learning Test |
| BIT | Behavioural Inattention Test |
| CAV | Contralateral arm vibration |
| CBS | Catherine Bergego Scale |
| CPA | Cyclical Pressure Application |
| CT | Control Therapy |
| CVA | Cerebral vascular accident |
| e-stim | Electrical stimulation |
| ET | Exploration training |
| FES | Functional Electrical Stimulation |
| FIM | Functional Independence Measure |
| FMA | Fugl-Meyer Assessment |
| FNI | Functional Neglect Index |
| FTHUE | Functional Tests for Hemiplegic UE |
| GRC | Government Rehabilitation Centre |
| L | Left |
| LAT | Limb activation therapy/treatment |
| LBT | Line Bisection Test |
| LN | Left neglect |
| LN-, | No neglect left lesion |
| MMSE | Mini Mental State Examination |
| MT | Mirror Therapy |
| MVTS | Movements |
| NS | Not significant |
| NT | Standard neglect tests |
| OKS | Optokinetic stimulation |
| PA | Prism Adaptation |
| PEDro | Physiotherapy Evidence Database |
| PIT | Picture Identification Task |
| QOL | Quality of life |
| R | Right |
| RCT | Randomized control trial |
| RCVA | Right cerebral vascular accident |
| RN-, | No neglect right lesion |
| rTMS | Repetitive Transcranial Magnetic Stimulation |
| SCT | Star Cancellation Test |
| SPT | Smooth Pursuit Training |
| TAP | Test of attentional performance |
| TENS | Transcutaneous electrical nerve stimulation |
| UBNI | Unawareness and behavioural neglect index |
| UE | Upper extremity |
| UN | Unilateral neglect |

| | |
|---|---|
| UNS | Unilateral neglect syndrome |
| USN | Unilateral spatial neglect |
| VSE | Visual scanning exercise |
| VST | Visual Scanning Therapy |
| w/ | With |
| w/o | Without |

# References

Bailey, M. J., Riddoch, M. J., & Crome, P. (2002). Treatment of visual neglect in elderly patients with stroke: A single-subject series using either a scanning and cueing strategy or a left-limb activation strategy. *Physical Therapy Journal, 82*(8), 782-797.

Dohle, C., Pullen, J., Nakaten, A., Kust, J., Rietz, C., & Karbe, H. (2009). Mirror therapy promotes recovery from severe hemiparesis: A randomized controlled trial. *Neurorehabilitation and Neural Repair, 23*(3), 209-217. doi:10.1177/1545968308324786 [doi]

Eskes, G. A., Butler, B., McDonald, A., Harrison, E. R., & Phillips, S. J. (2003). Limb activation effects in hemispatial neglect. *Archives of Physical Medicine and Rehabilitation, 84*(3), 323-328. doi:10.1053/apmr.2003.50012 [doi]

Ferreira, H. P., Leite Lopes, M. A., Luiz, R. R., Cardoso, L., & André, C. (2011). Is visual scanning better than mental practice in hemispatial neglect? Results from a pilot study. *Topics in Stroke Rehabilitation, 18*(2), 155-161. doi:10.1310/tsr1802-155

Fong, K. N., Yang, N. Y., Chan, M. K., Chan, D. Y., Lau, A. F., Chan, D. Y., . . . Chan, C. C. (2013). Combined effects of sensory cueing and limb activation on unilateral neglect in subacute left hemiplegic stroke patients: A randomized controlled pilot study. *Clinical Rehabilitation, 27*(7), 628-637. doi:10.1177/0269215512471959 [doi]

Gillen, G., Nilsen, D. M., Attridge, J., Banakos, E., Morgan, M., Winterbottom, L., & York, W. (2015). Effectiveness of interventions to improve occupational performance of people with cognitive impairments after stroke: An evidence-based review. *American Journal of Occupational Therapy, 69*(1), 1-9. doi:10.5014/ajot.2015.012138

Guariglia, C., Coriale, G., Cosentino, T., & Pizzamiglio, L. (2000). TENS modulates spatial reorientantion in neglect patients. *Neuroreport, 11*(9), 1945-1948.

Jutai, J. W., Bhogal, S. K., Foley, N. C., Bayley, M., Teasell, R. W., & Speechley, M. R. (2003). Treatment of visual perceptual disorders post stroke. *Topics in Stroke Rehabilitation, 10*(2), 77-106. doi:10.1310/07BE-5E1N-735J-1C6U

Kerkhoff, G., Bucher, L., Brasse, M., Leonhart, E., Holzgraefe, M., Völzke, V., . . . Reinhart, S. (2014). Smooth pursuit "bedside" training reduces disability and unawareness during the activities of daily living in neglect: A randomized controlled trial. *Neurorehabilitation and Neural Repair, 27*(9), 789-798. doi:10.1177/1545968313517757

Kerkhoff, G., Reinhart, S., Ziegler, W., Artinger, F., Marquardt, C., & Keller, I. (2013). Smooth pursuit eye movement training promotes recovery from auditory and visual neglect: A randomized controlled study. *Neurorehabilitation & Neural Repair, 27*(9), 789-798. doi:10.1177/1545968313491012

Klinke, M. E., Hafsteinsdottir, T. B., Hjaltason, H., & Jonsdottir, H. (2015). Ward-based interventions for patients with hemispatial neglect in stroke rehabilitation: A systematic literature review. *International Journal of Nursing Studies, 52*(8), 1375-1403. doi:10.1016/j.ijnurstu.2015.04.004

Lafosse, C. K., Kerckhofs, E., Troch, M., Vandenbussche, E. (2003). Upper limb exteroceptive somatosensory and proprioceptive sensory afferent modulation of hemispatial neglect. *Journal of Clinical & Experimental Neuropsychology, 25*(3), 308.

*Law, M. C., & MacDermid, J. (2008). *Evidence-based rehabilitation: A guide to practice*. Slack Incorporated.

Lisa, L. P., Jughters, A., & Kerckhofs, E. (2013). The effectiveness of different treatment modalities for the rehabilitation of unilateral neglect in stroke patients: A systematic review. *Neurorehabilitation, 33*(4), 611-620. doi:10.3233/NRE-130986

Luauté, J., Halligan, P., Rode, G., Rossetti, Y., & Boisson, D. (2006). Visuo-spatial neglect: A systematic review of current interventions and their effectiveness. *Neuroscience and Biobehavioral Reviews, 30*(7), 961-982. doi:10.1016/j.neubiorev.2006.03.001

Luukkainen-Markkula, R., Tarkka, I. M., Pitkänen, K., Sivenius, J., & Hämäläinen, H. (2009). Rehabilitation of hemispatial neglect: A randomized study using either arm activation or visual scanning training. *Restorative Neurology and Neuroscience, 27*(6), 663-672. doi:10.3233/RNN-2009-0520

Maddicks, R., Marzillier, S. L., & Parker, G. (2003). Rehabilitation of unilateral neglect in the acute recovery stage: The efficacy of limb activation therapy. *Neuropsychological Rehabilitation, 13*(3), 391-408. doi:10.1080/09602010244000264

*Maxton, C., Dineen, R. A., Padamsey, R. C., & Munshi, S. K. (2013). Don't neglect 'neglect'–an update on post stroke neglect. *International journal of clinical practice*, *67*(4), 369-378.

Pandian, J. D., Arora, R., Kaur, P., Sharma, D., Vishwambaran, D. K., & Arima, H. (2014). Mirror therapy in unilateral neglect after stroke (MUST trial): A randomized controlled trial. *Neurology, 83*(11), 1012-1017. doi:10.1212/WNL.0000000000000773

Pérennou, D. A., Leblond, C., Amblard, B., Micallef, J. P., Hérisson, C., & Pélissier, J. Y. (2001). Transcutaneous electric nerve stimulation reduces neglect-related postural instability after stroke. *Archives of Physical Medicine and Rehabilitation, 82*(4), 440-448.

Piccardi, L., Nico, D., Bureca, I., Matano, A., & Guariglia, C. (2006). Efficacy of visuo-spatial training in right-brain damaged patients with spatial hemineglect and attention disorders. *Cortex, 42*(7), 973-982.

Pitteri, M., Arcara, G., Passarini, L., Meneghello, F., & Priftis, K. (2013). Is two better than one? Limb activation treatment combined with contralesional arm vibration to ameliorate signs of left neglect. *Frontiers in Human Neuroscience, 7*(460), 1-10. doi:10.3389/fnhum.2013.00460

Polanowska, K., Seniów, J., Paprot, E., Lesniak, M., & Czlonkowska, A. (2009). Left-hand somatosensory stimulation combined with visual scanning training in rehabilitation for post-stroke hemineglect: A randomised, double-blind study. *Neuropsychological Rehabilitation, 19*(3), 364-382.

Reinhart, S., Schmidt, L., Kuhn, C., Rosenthal, A., Schenk, T., Keller, I., & Kerkhoff, G. (2012). Limb activation ameliorates body-related deficits in spatial neglect. *Frontiers in Human Neuroscience, 6*, 188. doi:10.3389/fnhum.2012.00188

Robertson, I. H., McMillan, T., M., MacLeod, E., Edgeworth, J., & Brock, D. (2002). Rehabilitation by limb activation training reduces left-sided motor impairment in unilateral neglect patients: A single-blind randomised control trial. *Neuropsychological Rehabilitation, 12*(5), 439-454.

Schröder, A.,Wist, E., & Hömberg, V. (2008). TENS and optokinetic stimulation in neglect therapy after cerebrovascular accident: A randomized controlled study. *European Journal of Neurology, 15*(9), 922-927. doi:10.1111/j.1468-1331.2008.02229.x

Seniów, J., Polanowska, K., Lesniak, M., & Czlonkowska, A. (2015). Adding transcutaneous electrical nerve stimulation to visual scanning training does not enhance treatment effect on

hemispatial neglect: A randomized, controlled, double-blind study. *Topics in Stroke Rehabilitation, 0*(0), 1-7.

Thieme, H., Bayn, M., Wurg, M., Zange, C., Pohl, M., & Behrens, J. (2013). Mirror therapy for patients with severe arm paresis after stroke--a randomized controlled trial. *Clinical Rehabilitation, 27*(4), 314-324. doi:10.1177/0269215512455651

Thieme, H., Mehrholz, J., Pohl, M., Behrens, J., & Dohle, C., MPhil (2012). Mirror therapy for improving motor function after stroke. *The Cochrane Database of Systematic Reviews, 3*, CD008449. doi:10.1002/14651858.CD008449.pub2

Ting, D. S. J., Pollock, A., Dutton, G. N., Doubal, F. N., Ting, D. S. W., Thompson, M., & Dhillon, B. (2011). Visual neglect following stroke: Current concepts and future focus. *Survey of Ophthalmology, 56*(2), 114-134. doi:10.1016/j.survophthal.2010.08.001

*Toglia, J. P. (1991). Generalization of treatment: A multicontext approach to cognitive perceptual impairment in adults with brain injury. *American Journal of Occupational Therapy, 45*(6), 505-516. doi:10.5014/ajot.45.6.505

Tyson, S., Wilkinson, J., Thomas, N., Selles, R., McCabe, C., Tyrrell, P., & Vail, A. (2015). Phase II pragmatic randomized controlled trial of patient led mirror therapy and lower limb exercises in acute stroke. *Neurorehab and Neural Repair, 29*(9), 818-26.

van Wyk, A., Eksteen, C. A., & Rheeder, P. (2014). The effect of visual scanning exercises integrated into physiotherapy in patients with unilateral spatial neglect poststroke: A matched-pair randomized control trial. *Neurorehabilitation and Neural Repair, 28*(9), 856-873. doi:10.1177/1545968314526306 [doi]

Yang, N. Y. H., Zhou, D., Chung, R. C. K., Li-Tsang, C. W. P., & Fong, K. N. K. (2013). Rehabilitation interventions for unilateral neglect after stroke: A systematic review from

1997 through 2012. *Frontiers in Human Neuroscience*, 7, 1-11.

http://doi.org/10.3389/fnhum.2013.0

*not included in this CAT table

# Involvement Plan

## Introduction

Our initial plan after discussion with our collaborator last semester was to provide a protocol for the interventions researched and potentially provide an in-service in his treatment setting. Our team participated in a follow-up meeting with our clinician collaborator to discuss how knowledge is usually translated in the Harborview In-Patient Rehabilitation unit. We also discussed potential ways our group could help facilitate that translation for our research topic. Generally, knowledge translation is difficult because of the typical barriers present when attempting to incorporate new evidence-based interventions into practice. Our collaborator identified that a lack of time and resources are the main barriers in his setting. He therefore stressed the importance of making our findings easy to follow and quick to implement. When asked if there was an opinion leader, or individual who usually spearheads implementation of new knowledge, he stated that he is typically the one who brings new ideas to the table. He mentioned that easy-to-read resource binders are the best way to improve access to new information for his colleagues.

We offered two ways to present our findings for our collaborator and his colleagues to incorporate the evidence-based interventions into practice. First, we could provide a single protocol for each intervention that was drafted from the highest level RCT for each. Second, we could provide a protocol that provided ranges for dosage, frequency, and application based on all of our research with citations for easy reference. Our collaborator opted for the second option as he felt that having a greater range of protocols to choose from would make it more applicable to a larger population of patients. We also mentioned that we would like to do a decision tree to help with ease of implementation. Our collaborator is concerned that this will be too difficult to

accurately achieve due to the complexity of hemi-inattention. However, he stated that a tree listing the contraindications for each intervention would be easier to create and very helpful in practice.

We agreed to provide a resource binder that includes a decision tree addressing contraindications, protocols for each intervention, and a copy of our final CAT paper. We provided a laminated copy of the decision tree to post in the clinic for easy access. We scheduled an in-service for April 22nd to share our findings with the therapy team at Harborview and explain the intervention protocols supported by our literature review. Therefore, practitioners will have written as well as face-to-face instruction on the protocols, which will help increase the likelihood of intervention implementation.

**Context**

We used the RE-AIM Model of Knowledge Translation (Palinkas & Soydan, 2012) to assess contextual factors that could possibly affect the knowledge translation process in our setting. For the clinicians at Harborview, a large majority of the patients present with some form of hemi-inattention. It is well within the scope of practice for occupational therapy practitioners to implement any four of the treatments researched. However, as the scope of OT is so broad, most practitioners in this setting are faced with multiple areas requiring rehabilitation and are forced to prioritize. Our collaborator explained that interventions for hemi-inattention were more likely to be used if they were easy to incorporate into already established treatments. This is because remediating successful participation in ADL is of the greatest focus in this setting.

As far as risk and benefit, it varies between each of the four interventions. Our hope is that a decision tree will allow practitioners to quickly assess the risk/benefit to a client if an intervention is implemented and thus help facilitate the clinical reasoning process without

requiring too much time of the practitioner. In this way, the likelihood that our research will be implemented into practice increases.

Harborview is a very fast-paced and demanding setting that does not lend itself to easy adoption of new intervention strategies because of the time required to research, practice, and implement proficiently. However, it is also considered a teaching hospital, and providing evidenced based practice and quality treatment is of high priority. Harborview values mentorship and the continuing education of its practitioners; therefore, it is our hope that providing easily referenced and implemented protocols will increase the likelihood of practitioner buy-in. This would result in practitioner collaboration and discussion as multiple clinicians begin implementing protocols.

The fidelity of implementation, or the certainty that the interventions will be implemented the way they were intended, could be compromised if practitioners do not fully follow the carefully created protocols we will provide. This can be overcome by creating a user-friendly protocol that is easy to read and understand with the help of clear and specific steps to follow. Additionally, the decision tree will allow for quick reference to ensure that interventions are implemented for the most appropriate patients.

Finally, the maintenance and sustainability of our intervention could be shortened if clinicians do not see the value in applying it, or if positive outcomes are not seen. This will be addressed by providing an in-service to relay information about the interventions. This will give us an opportunity to create practitioner buy-in through compelling evidence about positive outcomes and the effect they can have on the lives of clients.

Thus, our plan for implementation is geared to overcome potential barriers to knowledge translation at Harborview. It is our hope that the evidence provided through our protocols,

decision tree, and in-service will be compelling, motivating, feasible, and easily implemented. See Table 6 for an outline of the steps needed and due dates for our implementation plan.

During the in-service session we will solicit ideas from the Harborview team as to how they can best monitor and evaluate outcomes using the protocols provided. Our collaborating clinician has shared with us that the patients are there for only a short period of time, so it will be important to include the reasoning from the on-site providers as to what they believe would be appropriate and feasible measures to use in that setting. Once established, we will follow up with our collaborator via phone and/or email prior to the poster presentation to learn what barriers or supports are affecting the implementation. Due to time constraints this discussion will be for informational purposes only, although we will be willing to share these insights with a future research team who is interested in pursuing the implementation and outcome phase of this project. The collaborating clinician has expressed interest in continuing a relationship with our program on this and other research topics.

Table 6. Implementation Plan Outline

| Timeframe | Elements of Plan | Process |
|---|---|---|
| Week of 3/28 | Intervention Protocols | - Identify intervention protocols using research articles included in CAT<br>- Choose high quality studies w/ positive results<br>- Include ranges of protocols from the research and reference specific protocols as examples<br>- Include references for other cited protocols<br>- One protocol sheet per intervention (TENS, mirror therapy, VST, LAT) |
| Week of 4/4 | Decision Tree | - Identify populations and contraindications for each intervention<br>- Consult w/ project chair and collaborating clinician in decision making process |
| Week of 4/11 | Binder | - Include decision tree, 4 intervention protocol sheets, list of other possible interventions that weren't researched, and CAT table |
| Fri 4/22 12:15-1pm | In-service | - Present findings to OT therapy team at Harborview Medical Center Inpatient Rehab (Date TBD)<br>- Leave binder w/ therapy team as a resource<br>- Create laminated decision tree for their bulletin board |

## Knowledge Translation Activities: Process and Outcomes

After discussions with the collaborating clinician and project chair, the authors thought it would be most helpful to summarize each intervention separately for ease of implementation in the practice setting. The CAT table gave detailed information on each article that was included in the study, including the strength of evidence for each intervention; however, at quick glance it was difficult to pull out the useful information to quickly implement in treatment. Therefore, the authors decided to create one-page "cheat sheets" for each intervention to summarize the process and findings of the studies included in the CAT table. Basic information, such as, the rationale for the treatment, a description of how to set it up, the population it can be used for, dosage, frequency, and contraindications were included (see Appendix A for copy of each protocol sheet). This is meant to serve as a quick reference protocol to make it easier for practicing therapists to use in treatment.

The authors quickly realized that this task was a little more challenging than they had expected. Ideally, the studies for each intervention would have an agreed upon protocol with positive outcomes. However, this was not the case. In fact it seemed to be the opposite, since all of the included studies had a wide variety of set-up options, frequency, and dosage. This made it difficult to summarize the interventions in a meaningful and useful way. Since the authors could only communicate what the literature supports, they decided to include a range of protocols with examples from individual studies. This meant that there was no one way or right way to do the intervention. Therefore, practitioners have a large responsibility to apply their own clinical reasoning to any individual research study in order to use that knowledge with their clients. This process helped the authors realize even more the barriers that are present when trying to translate evidence into practice.

Providing a decision tree was another knowledge translation activity the authors intended to do. They hoped that it would be a helpful tool in the therapist decision making process when choosing which of the four interventions to use with a client. It would include a flowchart and questions to ask when presented with a client with certain characteristics. The authors started working on this and the protocol sheets simultaneously. They realized that there was no new information supported by the included studies that could be added to the decision tree that was not already included in the protocols. Again, they felt that this would be an ideal, straight-forward way to make a decision; however, it did not take into account the need for clinical reasoning and the complexity of the disorder. Hemi-inattention is a heterogenous condition which can manifest itself in a variety of ways. It does not lend itself to a "one size fits all" answer or approach. Therefore, with the guidance of the collaborating clinician and project chair, the authors decided not to create a decision tree and instead just focus on the protocol sheets. They all agreed that an easy to use protocol sheet would be a great asset to utilizing these new interventions in practice.

Lastly, the authors wanted to provide an in-service for the rest of the in-patient rehab occupational therapists at Harborview. They felt that it was important to create an opportunity for the whole team to hear about the project and how each studied intervention could be utilized to treat hemi-inattention in their treatment setting (see Appendix B for complete in-service presentation slides). They also wanted to hear feedback on the protocols and if there were any remaining gaps between the literature and clinical practice. The authors were scheduled for 45 minutes to give the in-service, but once they were presenting it felt like they could have easily taken a two hour session. Time was planned for the clinicians to practice each intervention in pairs and to problem solve a case study; however, more time was ultimately dedicated to

explaining how hemi-inattention might manifest, the research methods of the study, the evidence for each intervention, and the description of each protocol. The authors also felt that it was important to leave a few minutes for questions, comments, and time to fill out a survey to gage the effectiveness of knowledge translation (see Appendix C for feedback survey). In hindsight, the team would probably spend less time explaining their process of gathering the information and more time on the results and opportunities for group participation. Although the in-service did not go exactly as envisioned, because of time restraints, the overall feedback from the attending therapists was that the information was useful. See Table 7 for details.

The final product to promote knowledge translation in the inpatient rehabilitation therapy department was originally envisioned to be a reference binder that would include a decision tree, each intervention protocol, and a copy of the CAT table and references. The authors planned to have the binder finalized and leave it with the team on the day of the in-service. However, in creating the protocols and planning for the in-service, they decided that it would be more helpful in the knowledge translation process to ask for feedback on the protocols at the in-service. That way they could incorporate the feedback into the final product to make it more relevant and useful to the rehab team. The authors also decided to include a copy of the PowerPoint slides that they presented at the in-service for a quick reference of an overview of the project and outcomes (Appendix C). The final reference binder now includes a copy of each intervention protocol, a copy of the in-service PowerPoint slides, and a copy of the CAT table and references. The authors plan to present the final binder to their collaborating clinician at the poster symposium on May 12th or deliver it to Harborview if he is unable to attend.

**Schedule for meeting interim dates of completion**

| Due Date | Date completed | Elements of Plan | Process |
|---|---|---|---|
| Week of 3/28 | 3/30 | Intervention Protocols | - Identify intervention protocols using research articles included in CAT<br>- Choose high quality studies w/ positive results<br>- Include ranges of protocols from the research and reference specific protocols as examples<br>- Include references for other cited protocols<br>- One protocol sheet per intervention (TENS, mirror therapy, VST, LAT)<br>- Identify populations and contraindications for each intervention |
| Week of 4/4 | (decision to drop this component on 3/31) | Decision Tree | - Consult w/ project chair and collaborating clinician in decision making process |
| Week of 4/11 | 4/19 | Prepare for presentation | - 4 intervention protocol sheets, list of other possible interventions that were not researched, and CAT table<br>- Create presentation slides and get approval of project chair. |
| Fri 4/22 12:15-1pm | 4/22 | In-service | - Present findings to OT therapy team at Harborview Medical Center Inpatient Rehab<br>- Gather feedback on protocols<br>- Ask participants to fill out survey |
| Mon 4/25 | 4/25 | Synthesis and Interpretation | - Pull together all components of final paper.<br>- Update protocols with feedback from in-service and write up interpretation of that feedback.<br>- Complete executive summary and abstract |
| Tues 4/26 | 4/26 | Completion | - Turn in completed final paper w/ CAT |

## How outcomes were monitored

Monitoring outcomes was an integral part of the process from the beginning of this research project. The authors elicited input from their collaborating clinician during the process of formulating the researchable question, while gathering evidence, and after each draft of the CAT was completed. They also worked to build consensus on what sort of knowledge translation products would be most effective given his knowledge of the culture and expectations in his worksite. His input was gathered from email correspondence, during in person interview, and during Skype video meetings. Feedback was garnered from the project chair and faculty mentor via in person meetings, email correspondence, and as written comments. The authors received feedback on the following components of the project: all drafts of the CAT; the summary of implications for researchers, clinicians, and consumers; the involvement plan; the presentation slides, and written protocols that were the knowledge translation products.

A survey was developed to procure feedback on the effectiveness of the knowledge translation activities (Appendix B). The survey contained 4 questions: the helpfulness of the in-service, the relevance to the practice setting, the ease with which these interventions may be implemented, and how likely the clinicians were to implement this evidence into practice. Each participant in the in-service was asked to fill out a survey giving responses along a 5 point likert scale. The responses were, therefore, quantifiable as an average score for each question. Time was allowed following the in-service presentation to incorporate feedback into the finalized protocols delivered to the clinic site.

## Evaluation of the Effectiveness of Knowledge Translation Products

Survey results, clinician notes jotted on the protocols, and discussion comments suggested that the protocols and in-service presentation were helpful and relevant to the Harborview patient population and inpatient setting. Individual comments described the materials and presentation as

being “well-organized and easy to follow”, and “useful in this setting”. Seven occupational therapy providers attended the session and each completed a survey, the results of which are summarized in the following table.

Table 7. In-service Survey Results

| Survey Question | Average Rating |
|---|---|
| 1. How helpful was this in-service for you?<br>*Not at all helpful* 1 2 3 4 5 *Extremely helpful* | 4.3 |
| 2. How relevant is this information to your practice setting?<br>*Not at all relevant* 1 2 3 4 5 *Extremely relevant* | 4.9 |
| 3. How easy do you feel these interventions will be to implement in your practice setting?<br>*Not at all easy* 1 2 3 4 5 *Extremely easy* | 3.9 |
| 4. How likely are you to implement this evidence into your practice?<br>*Not at all likely* 1 2 3 4 5 *Extremely likely* | 4.4 |
| Additional Comments:<br>• Thank you! This was very helpful. I learned some new things and it was good to review others.<br>• Well-organized, easy to follow.<br>• Good info that is useful in this setting.<br>• Thanks so much! Each topic could be expanded on case studies if we had all the time in the world.<br>• Thanks for the valuable information and taking the time to present to us! | |

The ratings indicate that the occupational therapy team is likely to implement the evidence into practice and that they believe it should be relatively easy to do so. Additional questions in regard to specific settings of the TENS unit, cues for attending in MT, and where to purchase a Limb Activation Device in LAT further demonstrate their willingness to incorporate these protocols into their practice sessions. Discussion with the project chair during an informal meeting immediately following the presentation corroborated the occupational therapy team’s feedback in

regard to the presentation and protocols and supported the knowledge translation products as appropriate to the setting and project parameters. Had the knowledge translation process of the project been not constrained by time, additional hands-on intervention trainings with staff would have been ideal to ensure successful administration, however, each staff member rated the implementation of these interventions on their surveys as easy (3) to very easy (4) at this time.

An additional indicator of the perceived effectiveness and overall value of the research collaboration was illustrated by the interest of the occupational therapy providers to partner with University of Puget Sound (UPS) students on future research projects. Six out of the seven providers reported that they would consider working with a UPS student team, two clinicians already have topics in mind. Their interest to invest time into future research collaborations underscores the positive feedback they gave to describe the efficacy of the research and knowledge translation products that were provided.

As described earlier, a protocol for each intervention was distributed during the presentation to allow for review and feedback to ensure clarity and usefulness for the occupational therapy team before the final protocol manual was finalized and delivered to the site. Participants were encouraged to make comments and write questions directly on the protocols. Very few changes to the protocols were required at this stage; as they had been previously reviewed and edited specifically for this setting by the collaborating clinician, project chair, and faculty mentor. Nevertheless, the occupational therapy practitioners gave valuable feedback, such as a request for specific settings in the TENS intervention and questions about cuing for mirror therapy, that directly informed the final revision of the protocols to best meet the needs of the inpatient team. Many of the written questions stemmed from the clinicians' personal experience working with clients with hemi-inattention and demonstrated that they were actively engaging with the materials presented and planning how they might incorporate the information into their practice.

Overall, the in-service presentation and the intervention protocols proved to be informative and effective delivery methods of knowledge translation supported by the evidence presented in the CAT. The Harborview team were engaged in the in-service presentation, asked relevant follow-up questions, and showed interest in future research collaborations with University of Puget Sound occupational therapy students. The in-service presentation illustrated the methodology of the research investigation and described the evidence on which the protocols were based to provide meaningful knowledge translation to the Harborview inpatient team.

## Analysis of the Overall Process

A project as involved as this will always have positive and negative aspects to the process. In this case, open and clear communication, responsiveness, and strict adherence to deadlines were critical to the successful completion of this project; while unclear role delineation, and the novelty of the project both created some barriers that needed to be overcome for successful knowledge translation to occur.

Open, clear communication enabled the team to work with the collaborating clinician to develop a researchable PICO question that could realistically be critically appraised within the one-year timeline. The success of this project was largely due to the responsiveness of communication between team members, the faculty mentor, the faculty chair, and the collaborating clinician. Generally, it took between 48 and 72 hours for responses to occur. This allowed for maximum efficiency in the development, revision, and finalization process of the CAT and final paper.

Additionally, the authors found it most effective to set strict deadlines for their team, often making deadlines due several days prior to the specified submission date. This worked well and provided them ample opportunity to receive feedback from their faculty mentor and faculty chair. However, it was initially challenging to enact an organizational strategy that worked well for all group members in order to meet these expedited deadlines. There was an adjustment period where

the team explored several organizational strategies, in regards to role delineation and search strategy documentation, in order to promote the strengths of individual members and provide accurate data necessary for the CAT paper.

The process of knowledge translation initially seemed daunting, but became more accessible as the individual treatment protocols were created. The nature of creating a protocol required the team to approach this endeavor through the lens of translatable knowledge to ensure ease and feasibility of implementation in an inpatient rehabilitation setting. A survey turned out to be a very effective tool to measure how successful the attempts at knowledge translation were. However, because this was the first time such a project has been implemented in this way; retrospectively, it may have been beneficial to create another survey for the faculty chair to fill out. This would help to quantify how effective she perceived the efforts at knowledge translation to be. It also would have been beneficial to provide the in-service earlier in the semester in order to allow clinicians time to look over the protocols and provide more detailed feedback, rather than allowing them to list a few initial ideas in the last 5 minutes of the in-service. It also would have been beneficial to include a phase where the clinicians could pilot the interventions with their clients and provide feedback on the process. Doing more follow-up may have provided a more accurate representation of how effective the protocols were at meeting the implementation needs of this setting and its clinicians.

Finally, there were a few other difficulties during the process of this project. There were a few instances of confusion between the collaborating clinician and the research team as to the requirements of this project. For example, the collaborating clinician was not sure which direction to take the project after the initial CAT was completed or what his role entailed; again, this was largely due to the novelty of the project. There was also a minor miscommunication that resulted in the collaborating clinician not being present for the in-service presentation to his colleagues.

However, this is likely to have occurred regardless of the miscommunication due to the varied school schedules each student possessed.

Overall, the process of this project transitioned smoothly between each specific task and ultimately resulted in important findings that were deemed relevant and feasible to implement in this setting. All members of the team are pleased with the outcomes of this project, specifically with the fact that the time lapse between research and implementation into practice may have been reduced. This hopefully results in best practice in line with the American Occupational Therapy Association's centennial vision, and the improved well-being of clients.

## Recommendations for Future Projects

The final CAT paper summarizes two high-level RCTs that report significant improvement of hemi-neglect symptoms with the use of smooth pursuit training (SPT). In fact, SPT was found to be significantly more effective than VST at improving ipsilesional gaze deviation, perception of midline, and increased the amount of objects found in peri-personal space (Kerkhoff, et al., 2014; Kerkhoff, Reinhart, Zieglar, Artinger, Marquardt, & Keller, 2013).

SPT also generalized to other activities and situations, something that VST has difficulty doing, and the positive effects lasted longer than those of VST. This presents a fascinating opportunity to further explore SPT to determine if it may be more effective and/or feasible to treat hemi-inattention in an inpatient rehabilitation setting than the four interventions researched and presented in this paper.

Furthermore, the collaborating clinician expressed interest in researching an altogether different topic related to assistive technology and the use of switches in an inpatient rehabilitation setting. This could be used in addition to treating hemi-inattention, such as using switches as a means to incorporate limb activation. Another route this topic could go is to explore switch use for active participation and independence in ADL.

Finally, during the in-service, 6 out of 7 attending clinicians expressed interest in working with UPS students to research further questions. One clinician provided feedback on the survey that he/she would like to research the multi-context approach in order to develop a protocol that could be implemented systematically in the inpatient rehabilitation setting. All other clinicians did not specify a specific question, but stated that they would follow-up with the authors

## References

Kerkhoff, G., Bucher, L., Brasse, M., Leonhart, E., Holzgraefe, M., Völzke, V., . . . Reinhart, S. (2014). Smooth pursuit "bedside" training reduces disability and unawareness during the activities of daily living in neglect: A randomized controlled trial. *Neurorehabilitation and Neural Repair, 27(9), 789-798.* doi:10.1177/1545968313517757

Kerkhoff, G., Reinhart, S., Ziegler, W., Artinger, F., Marquardt, C., & Keller, I. (2013). Smooth pursuit eye movement training promotes recovery from auditory and visual neglect: A randomized controlled study. *Neurorehabilitation & Neural Repair, 27*(9), 789-798. doi:10.1177/1545968313491012

Palinkas, L. A., & Soydan, H. (2012). *Translation and implementation of evidence-based practice.* New York, NY: Oxford University Press.

Appendix A

Intervention Protocols

Protocols for each intervention developed for Harborview in-service.

# Intervention Protocol
# Transcutaneous Electrical Nerve Stimulation (TENS)

## Rationale

Transcutaneous electrical nerve stimulation (TENS) is a safe, well-established and inexpensive stimulation treatment that can be used on its own or employed simultaneously with visual scanning therapy (VST) or with other hemi-inattention treatments to alter the disturbed brain representation of spatial attention in patients with hemispatial neglect. (1)

## Description

Apply electrodes to patient's UE or shoulder on contralesional side depending on activity or patient comfort. Placement on hand is preferable but may limit use of the client's limb in activity.

- UE: cathode (negative) on upper middle part of the palm and anode (positive) on the forearm above the wrist. (2)
- Shoulder: cathode on upper trapezius between neck and shoulder and anode on neck below the occiput, just lateral to spine. (3, 4)
- Can be used simultaneously with VST and/or LAT treatments.

## Populations

- No motor return required.
- No sensation required (but use caution to ensure no damage to the client's skin).
- No awareness of deficit required.

## Dosage

Sub-threshold electrical stimulation has been reported to be sufficient to activate cortical areas. (2)

- Settings: Low setting recommended with maximum intensity of 15mA (settings vary by device, so decrease intensity if muscle twitch is observed). Consider self-reported comfort from patient.
- 25-45 minutes per single session/day
- May be recommended for HEP

**Frequency**

20 sessions/4 weeks with significant and lasting improvement reported between the 10th and 20th sessions. [2, 3]

**Contraindications**

- Pacemaker
- Seizure disorder
- Poor skin integrity
- Avoid electrode contact over wounds, rash, lesions

References

1. Seniów, J., Polanowska, K., Lesniak, M., & Czlonkowska, A. (2015). Adding transcutaneous electrical nerve stimulation to visual scanning training does not enhance treatment effect on hemispatial neglect: A randomized, controlled, double-blind study. *Topics in Stroke Rehabilitation, 0*(0), 1-7.
2. Polanowska, K., Seniów, J., Paprot, E., Lesniak, M., & Czlonkowska, A. (2009). Left-hand somatosensory stimulation combined with visual scanning training in rehabilitation for post-stroke hemineglect: A randomised, double-blind study. *Neuropsychological Rehabilitation, 19*(3), 364-382.
3. Guariglia, C., Coriale, G., Cosentino, T., & Pizzamiglio, L. (2000). TENS modulates spatial reorientantion in neglect patients. *Neuroreport, 11*(9), 1945-1948.
4. Schröder, A.,Wist, E., & Hömberg, V. (2008). TENS and optokinetic stimulation in neglect therapy after cerebrovascular accident: A randomized controlled study. *European Journal of Neurology, 15*(9), 922-927. doi:10.1111/j.1468-1331.2008.02229.x

# Intervention Protocol
# Mirror Therapy

## Rationale

Neuroimaging techniques have found that Mirror Therapy (MT) can result in cortical reorganization directing more cortical activation towards the affected hemisphere. [1, 2]

## Description

Use with BUE resting parallel to one another on table or tray and mirror (35 x 35cm to 55 x 55cm) between limbs in midsagittal plane. Keeping mirror near midline reduces need for neck rotation towards left. Place affected limb behind mirror, hidden from view. Client maintains attention on reflected image of unaffected limb throughout treatment. All movements should be performed with both limbs to whatever extent possible. Have client remove rings, watches, etc from both hands to avoid disruption of the illusion. Protocols begin with simple flexion and extension at wrist either fully supported or against gravity and progress towards functional movements including grasping and manipulating objects such as balls or sponges.

## Populations

- No motor return required.
- No sensation required.

## Dosage

- 30 min - 1 hour/day in either one continuous session or spread throughout day.

## Frequency

Frequency varied by study with three examples from three studies listed below.

- 5 days/week for 4 weeks. [3]
- 5 days/week for 6 weeks. [4]
- 20 sessions over 5 weeks. [5]

## Contraindications

- Sustained concentration on mirror may be fatiguing
- If lacking awareness of deficit, may require increased cuing to look left into mirror.
- Inability to clearly see reflected image.
- For some, the illusion just does not work.

References

1. Colomer, C., NOè, E., & Llorens, R. (2016). Mirror therapy in chronic stroke survivors with severely impaired upper limb function: a randomized controlled trial. *European journal of physical and rehabilitation medicine*.
2. Michielsen, M. E., Selles, R. W., van der Geest, J. N., Eckhardt, M., Yavuzer, G., Stam, H. J., ... & Bussmann, J. B. (2011). Motor Recovery and Cortical Reorganization after Mirror Therapy in Chronic Stroke Patients a Phase Ii Randomized Controlled Trial. *Neurorehabilitation and Neural Repair*,*25*(3), 223-233.
3. Pandian, J. D., Arora, R., Kaur, P., Sharma, D., Vishwambaran, D. K., & Arima, H. (2014). Mirror Therapy in Unilateral Neglect After Stroke (MUST trial) A randomized controlled trial. *Neurology*, *83*(11), 1012-1017.
4. Dohle, C., Püllen, J., Nakaten, A., Küst, J., Rietz, C., & Karbe, H. (2009). Mirror therapy promotes recovery from severe hemiparesis: a randomized controlled trial. *Neurorehabilitation and neural repair*, *23*(3), 209-217.
5. Thieme, H., Bayn, M., Wurg, M., Zange, C., Pohl, M., & Behrens, J. (2013). Mirror therapy for patients with severe arm paresis after stroke–a randomized controlled trial. *Clinical rehabilitation*, *27*(4), 314-324.

# Intervention Protocol
# Limb Activation Therapy (LAT)

## Rationale

Using LAT for unilateral neglect is based on the theory that movement of the contralesional limb will activate the motor circuits in the damaged brain hemisphere and reorganized neural pathways to increase attention to the neglected, contralesional side of space.(1) This is due to the strong link between the proprioceptive representations in the brain and the external visual representations.(2)

## Description

LAT can either be passive using Functional Electrical Stimulation (FES) or active where the patient voluntarily initiates the movement.(3) One option is to implement using a limb activation device (LAD) which encourages patients with left unilateral neglect to make small movements with the hemiparetic left side of their body.(2) The LAD is a wrist-watch type device and placed on the patient's left wrist. It is set to emit a vibration cue and/or an auditory signal at a predetermined time interval and turns off once movement of the limb or pressing a switch occurs.(4)

## Patient Characteristics

- Range 5 days to 13 years post-CVA, most subjects ranged 8-21 weeks post-CVA
- Voluntary motor control
- Personal neglect (5)

## Protocol & Dosage

Studies included examples of the following activities:

- Solve visuoperceptual tasks (reading, writing, crossword puzzles, jigsaw puzzles, dominos, playing cards) and perform active LAT while wearing an LAD set at 30 sec intervals for 45 min. (2)
- Press a button on cueing device w/ R hand as soon as possible after every cue. Cues set at 5 min. intervals for 3 hours. Perform 5 consecutive movements in elbow flex/ext or shoulder flex/abd depending on motor control after each cue. (4)
- Complete target detection task (eg: Star Cancellation, Dynavision) and simultaneously: (3)
    - *Active:* Press switch on mouse 2x with left hand after beep set at 8-12 seconds interval
    - *Passive:* FES stimulation w/ electrodes placed on forearm over muscle mass of L finger extensors [frequency: 30 pulse/sec, pulse: 0.2 ms, time on: 4 sec, time off: 10 sec].

## Frequency

- No agreed upon protocol. Studies included these frequencies:
    - 3 hours/day, 5 days/week, 3 weeks (4)
    - 45 minutes/day, 1 day/week, 12 weeks (2)

## Contraindications

- Complete paralysis of affected side

References

1. Maddicks, R., Marzillier, S. L., & Parker, G. (2003). Rehabilitation of unilateral neglect in the acute recovery stage: The efficacy of limb activation therapy. *Neuropsychological Rehabilitation, 13*(3), 391-408. doi:10.1080/09602010244000264
2. Robertson, I. H., McMillan, T., M., MacLeod, E., Edgeworth, J., & Brock, D. (2001). Rehabilitation by limb activation training reduces left-sided motor impairment in unilateral neglect patients: A single-blind randomised control trial. *Neuropsychological Rehabilitation, 12*(5), 439-454.
3. Eskes, G. A., Butler, B., McDonald, A., Harrison, E. R., & Phillips, S. J. (2003). Limb activation effects in hemispatial neglect. *Archives of Physical Medicine and Rehabilitation, 84*(3), 323-328. doi:10.1053/apmr.2003.50012 [doi]
4. Fong, K. N., Yang, N. Y., Chan, M. K., Chan, D. Y., Lau, A. F., Chan, D. Y., . . . Chan, C. C. (2013). Combined effects of sensory cueing and limb activation on unilateral neglect in subacute left hemiplegic stroke patients: A randomized controlled pilot study. *Clinical Rehabilitation, 27*(7), 628-637. doi:10.1177/0269215512471959 [doi]
5. Parton, A., Malhotra, P., & Husain, M. (2004). Hemispatial neglect. *Journal of Neurology, Neurosurgery & Psychiatry*, 75, 13-21.

# Intervention Protocol

# Visual Scanning Therapy (VST)

## Rationale

Providing patients with a visual scanning strategy that allows them to self-cue to attend to the affected side is hypothesized to be more effective than simply cueing them repeatedly to attend. However, research is mixed regarding the effectiveness of VST and little to no generalization to untrained tasks has been found [1].

## Description

There are a variety of ways in which to implement visual scanning therapy. Commonalities in intervention protocols that were used in 2 or more articles are provided below.

- Cue clients to scan from left to right. [1, 2, 3, 4]
- Visual cues/anchors can also be provided on the affected side. You can place a shiny ribbon and instruct patients to scan to the left until they see it or you can cue them to scan until they see their affected UE. [1, 5, 6]
- Progress scanning activities from simple to complex and finally to activities that have distracting material (but only once the first two activities have been successful). [1, 2, 6, 7, 8]
    - I.e. First have them read 2 lines, then 3, etc.
- Using both verbal and physical cues to help the client scan to the left. [1, 2, 3]
- Copying a dot matrix on the left onto a matrix on the right. [1, 6, 7]
- Reading and copying the material read. [1, 6, 7]
- Clients were given a picture and asked to describe the scene or to find certain objects in the scene. [1, 7]
- Clients were asked to scan the ward or treatment facility they were in and describe it to the therapist. [1, 2]
- Digits appeared on a screen and clients were asked to identify them in varying ways as they scanned from left to right. [3, 4, 7]

## Populations

- No motor return required
- If there is no awareness of deficit (anosognosia), VST is likely to be ineffective at generalizing to other activities until awareness is achieved.

## Dosage

- At least throughout 30 minutes of focused treatment on the scanning strategy every day, although no specific time for just VST training is specified. It is helpful for generalizability if the strategy is incorporated throughout daily tasks and other treatment sessions.

## Frequency

- No set frequency has been determined. One systematic review found that results were greater when the training program lasted longer than 1 month. (5)
- Should be incorporated throughout other treatments such as dressing and self-care tasks.
- It is important to have other team members, including family, implement this strategy to increase consistency.

## Contraindications

- Must achieve awareness before VST can be expected to generalize

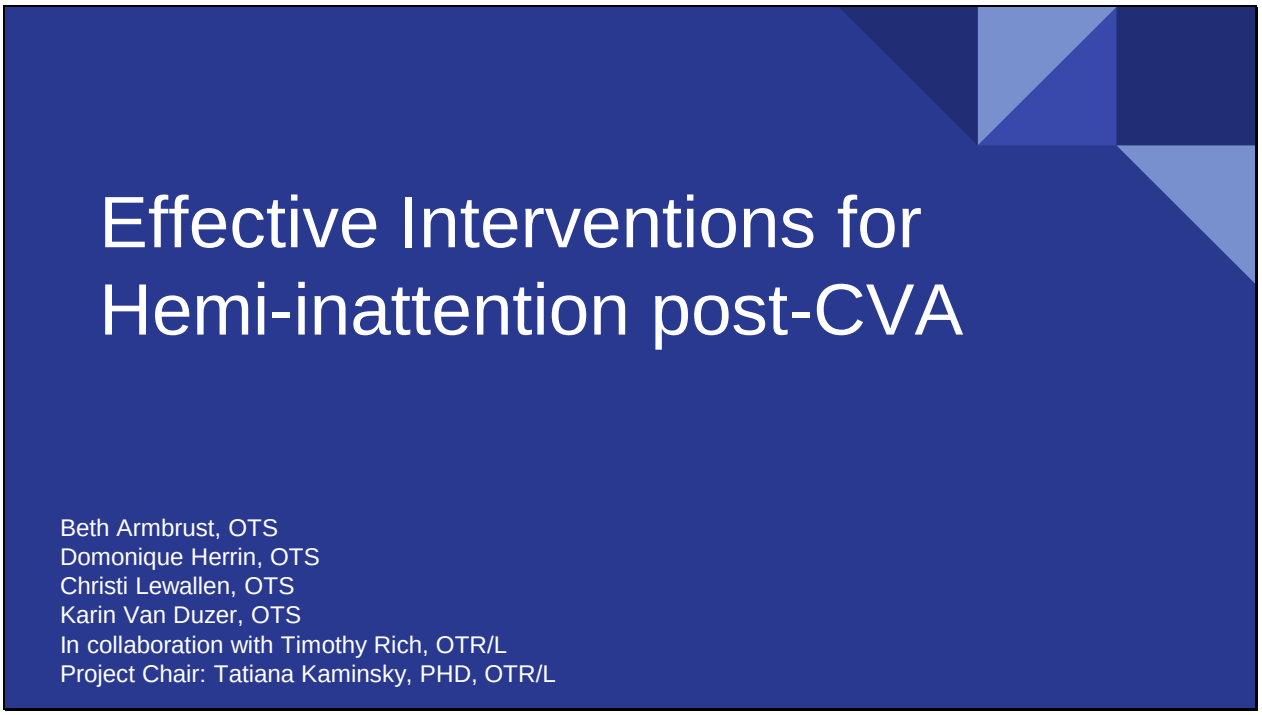
References


1. Bailey, M. J., Riddoch, M. J., & Crome, P. (2002). Treatment of visual neglect in elderly patients with stroke: A single-subject series using either a scanning and cueing strategy or a left-limb activation strategy. *Physical Therapy Journal, 82*(8), 782-797.
2. Ferreira, H. P., Leite Lopes, M. A., Luiz, R. R., Cardoso, L., & André, C. (2011). Is visual scanning better than mental practice in hemispatial neglect? Results from a pilot study. Topics in Stroke Rehabilitation, 18(2), 155-161. doi:10.1310/tsr1802-155
3. Kerkhoff, G., Bucher, L., Brasse, M., Leonhart, E., Holzgraefe, M., Völzke, V., . . . Reinhart, S. (2014). Smooth pursuit "bedside" training reduces disability and unawareness during the activities of daily living in neglect: A randomized controlled trial. *Neurorehabilitation and Neural Repair, 27(9), 789-798.* doi:10.1177/1545968313517757
4. Kerkhoff, G., Reinhart, S., Ziegler, W., Artinger, F., Marquardt, C., & Keller, I. (2013). Smooth pursuit eye movement training promotes recovery from auditory and visual neglect: A randomized controlled study. *Neurorehabilitation & Neural Repair, 27*(9), 789-798. doi:10.1177/1545968313491012
5. Luauté, J., Halligan, P., Rode, G., Rossetti, Y., & Boisson, D. (2006). Visuo-spatial neglect: A systematic review of current interventions and their effectiveness. *Neuroscience and Biobehavioral Reviews, 30*(7), 961-982. doi:10.1016/j.neubiorev.2006.03.001
6. Luukkainen-Markkula, R., Tarkka, I. M., Pitkänen, K., Sivenius, J., & Hämäläinen, H. (2009). Rehabilitation of hemispatial neglect: A randomized study using either arm activation or visual scanning training. *Restorative Neurology and Neuroscience, 27*(6), 663-672. doi:10.3233/RNN-2009-0520
7. Piccardi, L., Nico, D., Bureca, I., Matano, A., & Guariglia, C. (2006). Efficacy of visuo-spatial training in right-brain damaged patients with spatial hemineglect and attention disorders. *Cortex, 42*(7), 973-982.
8. van Wyk, A., Eksteen, C. A., & Rheeder, P. (2014). The effect of visual scanning exercises integrated into physiotherapy in patients with unilateral spatial neglect poststroke: A matched-pair randomized control trial. *Neurorehabilitation and Neural Repair, 28*(9), 856-873. doi:10.1177/1545968314526306 [doi]

Appendix B

In-service Presentation Slides

Complete set of slides from in-service presentation.



## Collaboration/Translational Research

**Goal:** To make evidence-based practice a clinical reality.

**Problem:** Practicing clinicians have many clinical questions but little time to search the literature to incorporate best practice.

**Solution:** Collaboration between clinicians and students!

## The Question

1. Which intervention/s available to occupational therapists is the most effective for remediating hemi-inattention post CVA?
2. What is the most pragmatically feasible intervention for hemi-inattention post CVA for this hospital inpatient rehabilitation setting?

## Quick Check-in:

Do you feel like you have a good understanding of hemi-inattention?

Not Really 1 2 3 4 5 I'm an expert

Do you feel like you know what to do for clients w/ hemi-inattention?

No Idea what to do 1 2 3 4 5 I know exactly

## What do we know about hemi-inattention?

Lots of names: unilateral spatial neglect, hemi-neglect, visuospatial neglect

A cognitive/perceptual issue

Not due to a disruption in primary sensory systems (e.g.: visual field cut)

Not a motor deficit

Heterogeneous condition (perceptual, representational, motoric, motivational, or a combination)

(Kaminsky, 2015)

## What do we know about hemi-inattention?

Associated w/ poorer outcomes (safety concerns, ADL, IADL)

**Disorganized**, incomplete visual scanning

3 types of space that may be impacted:

- Personal
- Peripersonal
- Extrapersonal

Often have some level of anosognosia (lack of awareness)

(Kaminsky, 2015)

## How do you assess for hemi-inattention?

Skilled observation in functional tasks

Catherine Bergego Scale

Baking Tray Task

Scan board

Behavioral Inattention Task

- Line bisection
- Cancellation test
- Figure copy
- Representational drawing

(Kaminsky, 2015)

## How do you treat hemi-inattention?

Well…

let's go to the research!!

## Process

Research question initiated during initial clinician meeting

Developed searchable PICO question with guidance from project chair

Established list of interventions through team and faculty mentor meetings

Refined list with clinician based on available onsite resources

Finalized list of interventions included:

- Visual scanning therapy (VST)
- Transcutaneous electrical nerve stimulation (TENS)
- Mirror therapy
- Limb activation therapy (LAT)

## Search Strategy

| Categories | Key Search Terms |
|---|---|
| Diagnosis | Hemi-inattention, Hemineglect, Unilateral inattention, Unilateral neglect, Visual inattention, Hemispatial neglect, Right neglect, Left neglect, Hemispatial inattention, Visual hemispatial inattention, Hemiagnosia, Neglect Syndrome, Contralateral hemispatialagnosia |
| Client population | Stroke, Cerebral vascular accident, Cerebral ischemic, Cerebral thrombosis, CVA |
| Interventions | Visual Scanning Therapy (aka VST, Lighthouse), Transcutaneous Electrical Nerve Stimulation (aka TENS, Somatosensory Stimulation, Somatosensory electrostimulation), Mirror Therapy, Limb Activation Therapy |
| Comparisons | Effective, Feasible, Cost-effective |

## Inclusion criteria

Studies published in English from 2000 to present.

Adult stroke patients with diagnosis of hemi-inattention (or related synonym).

Studies related to the following interventions, Visual Scanning Therapy, Transcutaneous Electrical Nerve Stimulation, Limb Activation, and Mirror Therapy

Systematic Reviews/Meta Analyses for post stroke intervention that included at least one of the above listed interventions and the impact on hemi-inattention as an outcome.

## Exclusion criteria

Diagnosis of hemi-inattention due to something other than CVA (e.g., TBI).

Studies that do not include at least one of the four interventions (VST, MT, TENS, LAT).

Studies on non-human subjects.

Studies on individuals < 18 years of age.

Interventions that are outside of the practice of OT (e.g., prisms and transcranial magnetic stimulation)

Non-research papers (editorials, opinion papers, general information)

## Databases and sites searched

Pubmed/Medline
Google Scholar
CINAHL
Cochrane Library
Stroke Engine
OT Seeker
American Journal of Occupational Therapy
British Journal of Occupational Therapy
Canadian Journal of Occupational Therapy
International Stroke
Evidence-Based Review of Stroke Rehabilitation
Google Scholar

## Search Results

| Pyramid Evidence Level | Study Design | Number of Articles Selected |
|---|---|---|
| Experimental | 8 Meta-Analyses of Experimental Trials<br><br>14 Individual Blinded Randomized Controlled Trials<br>3 Controlled Clinical Trials<br><br>3 Single Subject Studies | 28 |
| Outcome | 2 One Group Pre-Post Studies | 3 |
| Qualitative | 0 | 0 |
| Descriptive | 0 | 0 |
| | | Total Number of Articles: 31 |

## Results Summary

Good news!

All 4 interventions are effective and backed up by good quality research.

Evidence supports use individually, in concert or in series.

VST lacks generalizability, so it is important to consider a deliberate approach to transfer of strategy, such as by using the multicontextual approach.

(Toglia, 1991)

## VST

**How does it work?**
Creation of a visual scanning strategy that patients can utilize themselves

**How do you set it up?**
Variety of ways can be used.

- Teach scanning from left to right
- Saccadic eye movements
- Lighthouse
- Progression from simple to complex
- Use of specific interventions to practice skill
  - Dot Matrix
  - Reading/Copying
  - Scene/Surroundings description
  - Digital scanning on a screen
  - Anchors
  - Multicontextual Approach for skill transfer

## VST

**Frequency and Dosage?**
Not readily agreed upon.

- Program >1 month
- Consistent usage among team members/family
- 30 min/day
- Incorporate throughout other activities

**Who is it good for?**
Individuals post CVA with hemi-inattention

- With resulting decreased mobility, hemiplegia, and/or hemiparesis

**Not good for?**
Individuals who are unaware (anosagnosia) of their hemi-inattention.

- Lack of generalizability
- Results in constant cueing rather than utilization by the patient
- Caution with field-cuts

# VST vs SPT

**What is Smooth Pursuit Training?**

Use of smooth pursuit eye movements to track moving objects from the right hemispace into the left hemispace.

**Interesting Findings**

Two high level RCTs found SPT to be significantly more effective than VST (Kerkhoff, et al., 2014; Kerkhoff, Reinhart, Zieglar, Artinger, Marquardt, & Keller, 2013).

- Improvements finding/grasping objects
- Improved perception of midline
- Ipsilesional gaze deviation normalized
- Decreased auditory neglect/auditory midline

**Opportunity for further research!**

# Mirror Therapy

**How does it work?**

Sensory feedback seems to be coming from affected limb and results in cortical reorganization with shift in activity towards affected hemisphere.

**How do you set it up?**

Equipment: mirror box and a surface to work on.

## Mirror Therapy

## Mirror Therapy

**Frequency and Dosage?**

30min - 1 hr per day. Need not be continuous.

5 days per week for 4-6 weeks (can be done as home program).

**Who is it good for?**

No motor return required.

No sensory return required.

**Not good for?**

Sustained concentration on mirror may be fatiguing.

If lacking awareness of deficit, may require cuing to look left into mirror.

Inability to clearly see reflected image.

# Limb Activation Therapy (LAT)

**How does it work?**

Movement in the affected limb helps build neural connections in the damaged hemisphere and increase attention to contralesional side of space.

**How do you set it up?**

- Passive LAT
  - Functional Electrical Stimulation (FES) to hemiparetic wrist/finger extensors
  - Sensory input might conflict w/ motor response
- Active LAT
  - Goal-directed movement on timed intervals
  - One option: use a limb activation device (LAD) on hemiparetic limb to emit sound/vibration and cue patient to move limb

# LAT

**Protocol and Dosage?**

- Solve visuoperceptual tasks w/ LAD (30 sec intervals for 45 min.)
- Press button on cue device w/ R hand (5 min. intervals for 3 hours) AND perform 5 consecutive movements of elbow flex/ext or shoulder flex/abd
- Complete target detection task AND press switch on mouse 2x w/ L hand after beep (8-12 sec. interval) OR FES to forearm extensors (passive)

**Frequency?**

Not agreed upon, but studies included:

- 3 hours/day, 5 days/week, 3 weeks
- 45 minutes/day, 1 day/week, 12 weeks

**Who is it good for?** Voluntary motor control, Personal neglect

**Not good for?** Complete paralysis of affected side

# Transcutaneous electrical nerve stimulation (TENS)

## How does it work?

Electrical stimulation treatment through device to alter the disturbed brain representation of spatial attention in patients with hemispatial neglect.

## How do you set it up?

Apply electrodes to patient's contralesional side, choose between:

UE: cathode (negative) on upper middle part of the palm and anode (positive) on the forearm above the wrist.

Shoulder: cathode on upper trapezius between neck and shoulder and anode on neck below the occiput, just lateral to spine.

Sub-threshold electrical stimulation has been reported to be sufficient to activate cortical areas. See specific device instructions and use client feedback for appropriate and comfortable settings.

# TENS

## Frequency and Dosage?

25-45 min per single session/day
May be recommended for HEP
20 sessions/4 weeks found significant and lasting improvements
Can be used simultaneously with VST, LAT or other treatments

## Who is it good for?

Individuals post CVA with hemi-inattention
No motor return required
No sensation required (but use caution to ensure skin safety)
No awareness of deficit required

## Not good for?

Individuals with pacemaker
Patients with seizure disorder
Patients with poor skin integrity
Avoid electrode contact over wounds, rash, lesions

# Case Example

**Anyone having difficulty treating hemi-inattention with their client?**

Given what we've learned today, do you have any ideas of how you can address it now?

**Case Example**

Lenny is a 58 y.o. white male who has been admitted after a R MCA CVA. You notice that he does not scan for grooming items at the sink in an organized way and consistently does not notice items on the left side. He has moderate L hemiparesis, with significant spasticity. When cued, he can move his LUE into a flexor synergistic pattern to assist with ADL.

What are some ways you can help Lenny work on attending to his left side on his own?
How would you go about treating his hemi-inattention specifically?

# References

Kaminsky, T. (2015). *Hemi-inattention* [PowerPoint slides].

Kerkhoff, G., Bucher, L., Brasse, M., Leonhart, E., Holzgraefe, M., Völzke, V., . . . Reinhart, S. (2014). Smooth pursuit "bedside" training reduces disability and unawareness during the activities of daily living in neglect: A randomized controlled trial. *Neurorehabilitation and Neural Repair, 27(9),* 789-798. *doi:10.1177/1545968313517757*

Kerkhoff, G., Reinhart, S., Ziegler, W., Artinger, F., Marquardt, C., & Keller, I. (2013). Smooth pursuit eye movement training promotes recovery from auditory and visual neglect: A randomized controlled study. *Neurorehabilitation & Neural Repair, 27(9),* 789-798. doi:10.1177/1545968313491012

Toglia, J. P. (1991). Generalization of treatment: A multicontext approach to cognitive perceptual impairment in adults with brain injury. *American Journal of Occupational Therapy, 45(6)*, 505-516. doi:10.5014/ajot.45.6.505

## What would Adele do??


# Appendix C

## Post In-service Survey

This survey was developed to gather feedback from clinicians participating in in-service training at Harborview Medical Center.

### Interventions for Hemi-inattention In-service Survey

1. How helpful was this in-service for you?
   *Not at all helpful* 1 2 3 4 5 *Extremely helpful*
   Comments:

2. How relevant is this information to your practice setting?
   *Not at all relevant* 1 2 3 4 5 *Extremely relevant*
   Comments:

3. How easy do you feel these interventions will be to implement in your practice setting?
   *Extremely difficult* 1 2 3 4 5 *Extremely easy*
   Comments:

4. How likely are you to implement this evidence into your practice?
   *Not at all likely* 1 2 3 4 5 *Extremely likely*
   Comments:

5. Would you consider working with UPS students on a future research project? (circle one)
   Yes No

   If yes, do you have a specific clinical question or topic in mind?

   Additional Comments:

**Permission for Scholarly Use of Thesis**

To properly administer the Research Repository and preserve the contents for future use, the University of Puget Sound requires certain permissions from the author(s) or copyright owner. By accepting this license, I still retain copyright to my work. I do not give up the right to submit the work to publishers or other repositories. By accepting this license, I grant to the University of Puget Sound the non-exclusive right to reproduce, translate (as defined below), and/or distribute my submission (including the abstract) worldwide, in any format or medium for non-commercial, academic purposes only. The University of Puget Sound will clearly identify my name(s) as the author(s) or owner(s) of the submission, including a statement of my copyright, and will not make any alteration, other than as allowed by this license, to my submission. I agree that the University of Puget Sound may, without changing the content, translate the submission to any medium or format and keep more than one copy for the purposes of security, back up and preservation. I also agree that authorized readers of my work have the right to use it for non-commercial, academic purposes as defined by the "fair use" doctrine of U.S. copyright law, so long as all attributions and copyright statements are retained. If the submission contains material for which I do not hold copyright and that exceeds fair use, I represent that I have obtained the unrestricted permission of the copyright owner to grant the University of Puget Sound the rights required by this license, and that such third-party owned material is clearly identified and acknowledged within the text or content of the submission. I further understand that, if I submit my project for publication and the publisher requires the transfer of copyright privileges, the University of Puget Sound will relinquish copyright, and remove the project from its website if required by the publisher.

Name: _____ Date:_____

_____
Signature of MSOT Student

Name: _____ Date:_____

_____
Signature of MSOT Student

Name: _____ Date:_____

_____
Signature of MSOT Student

Name: _____ Date:_____

_____
Signature of MSOT Student