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Canadian Partnership for Stroke Recovery

Chapter 13: Rehabilitation of Unilateral Spatial Neglect

Abstract

This review examines rehabilitation interventions for unilateral spatial neglect following stroke. Unilateral spatial neglect occurs in approximately 25% to 30% of stroke survivors and is more commonly associated with right hemisphere lesions involving frontoparietal attention networks. The presence of neglect has been associated with poorer functional recovery, longer rehabilitation stays, reduced independence, and increased need for assistance following discharge. In general, rehabilitation interventions for unilateral spatial neglect may be broadly classified into either compensatory approaches that aim to increase awareness of and attention toward neglected space, or restorative approaches that target impairments in spatial representation, sensory integration, or body orientation. Examples of compensatory interventions include visual scanning retraining, arousal and activation strategies, cueing, and feedback to increase awareness of neglect-related behaviours. Restorative approaches include prism adaptation, eye patching, optokinetic stimulation, neck vibration, caloric stimulation, transcutaneous electrical nerve stimulation, and sensory stimulation techniques. More recently, neuromodulation approaches such as repetitive transcranial magnetic stimulation, theta burst stimulation, and transcranial direct current stimulation have also been explored.

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Chapter 13: Rehabilitation of Unilateral Spatial Neglect

Key Points

Note: The following key points provide a summary of the current evidence for interventions targeting unilateral spatial neglect (USN) recovery after stroke. Readers are encouraged to consult the chapter methodology and evidence tables for each intervention to better understand the study characteristics, intervention details, dosage, and outcome-specific efficacy. Evidence should be interpreted and applied in clinical practice with caution, as the evidence base for USN rehabilitation remains limited relative to other areas of post-stroke rehabilitation (Mehrabi et al., 2026), and consideration of individual study details and level of evidence are essential for informed clinical interpretation.

- The literature is mixed regarding visual scanning training for improving USN or neglect-specific activities of daily living (ADLs) compared to conventional therapies.
- Non-invasive brain stimulations and transcutaneous electrical nerve stimulations (TENS) added to visual scanning training may not have a difference in efficacy compared to visual scanning alone for improving USN.
- Smooth pursuit eye movement training may be beneficial in improving USN and neglect-specific ADLs compared to visual scanning training.
- The literature is mixed regarding virtual reality-based training for improving USN compared to conventional rehabilitation.
- Virtual reality-based training may not be beneficial for improving neglect-specific or general ADLs compared to conventional rehabilitation.
- Virtual reality attention training may not be beneficial for improving USN outcomes but effective for improving neglect-specific or general ADLs compared to visual scanning training and object gaze task.
- Cued limb activation may not be beneficial for improving USN and general ADLs when compared to conventional rehabilitation.
- Constraint induced therapy either with or without eye patching may not have a difference in efficacy compared to conventional rehabilitation or constraint induced therapy alone for improving USN or neglect-specific ADLs.
- Limb activation added to perceptual training may not have a difference in efficacy compared to perceptual training alone for improving USN, neglect-specific ADLs, and general ADLs.
- Cuing and strategy-based visual scanning training, body awareness training combined with task specific training compared to task specific training, and robot-assisted training with sensory feedback may be beneficial for improving USN.

- Eye tracking glasses with biofeedback, rod balancing task training, visual perception motion tracking program, visuomotor imagery training, and kinesthetic ability training may not be beneficial for improving USN; and mirror therapy and contra-lesional sensory stimulation showed mixed evidence for improving USN. However, the number of studies is very limited.

- Cuing and strategy-based visual scanning training showed beneficial effects, mirror therapy and robot-assisted training with sensory feedback showed mixed effect, and visual perception motion tracking program did not show beneficial effects on improving neglect specific-ADLs. However, the number of studies is very limited.

- Cuing and strategy-based visual scanning training, body awareness training combined with task specific training, mirror therapy, and rod balancing task training may be beneficial for improving general ADLs.

- Contra-lesional sensory stimulation, visual perception motion tracking program, and kinesthetic ability training may not be beneficial for improving general ADLs. However, the number of studies is very limited.

- Prism adaptation may not be beneficial for improving USN, neglect-specific ADLs, general ADLs, and global cognition when compared to conventional rehabilitation.

- Prism adaptation combined with functional electrical stimulation may be beneficial for improving USN and neglect-specific ADLs when compared to either therapy alone.

- Methylphenidate added to prism adaptation may not be beneficial for improving USN or global cognition but may be beneficial for improving neglect-specific or general ADLs, when compared to prism adaptation alone.

- Eye patching may not be beneficial for improving neglect, neglect specific ADLs, and general ADLs, alone or as an adds-on therapy, when compared to conventional rehabilitation.

- Bon Saint Come trunk training device compared to conventional rehabilitation may be beneficial for improving USN, but the evidence is mixed regarding it effect on general ADLs.

- Individuals with neglect may have better performance on USN assessment tests in the supine and standing position compared to the sitting position.

- Trunk rotation therapy combined with eye-patching may not be beneficial for improving USN and general ADLs, compared to eye-patching alone or conventional rehabilitation.

- Computer-based cognitive training may not be beneficial for improving USN.

- Perceptual training may not be beneficial for improving USN and general ADLs.

- Music therapy and multi-component cognitive attention treatment may be beneficial for improving USN and general ADLs when compared to conventional/sham therapy.

- Neck muscle vibration added to visual exploration may be beneficial for improving USN and general ADLs compared to visual exploration alone.
- Neck muscle vibration added to prism adaptation may be beneficial for improving USN and neglect-specific ADLs compared to neck muscle vibration alone.
- Neck muscle taping may not be beneficial for improving USN and neglect-specific ADLs compared to sham taping.
- TENS added to visual scanning training may not be beneficial for improving neither USN nor global cognition compared to visual scanning training alone.
- Electrical Somatosensory Stimulation combined with visual scanning training may be beneficial for improving USN compared to visual scanning training alone.
- Low-frequency repetitive transcranial magnetic stimulation (rTMS) and high-frequency rTMS may be beneficial for improving USN, but not general ADLs, when compared to sham rTMS/conventional rehabilitation.
- High-frequency and low-frequency rTMS may not have any difference with each other for improving USN.
- Continuous theta burst stimulation (TBS) may be beneficial for improving USN, neglect-specific ADLs, and general ADLs when compared to sham stimulation.
- Continuous TBS added to prism adaptation may not be beneficial for improving USN or general ADLs when compared to prism adaptation alone.
- Anodal transcranial direct current stimulation (tDCS) either alone or as an adjunct therapy may be beneficial for improving USN, but not neglect-specific or general ADLs, compared to sham stimulation.
- Cathodal tDCS may not be beneficial for improving USN, neglect-specific or general ADLs, compared to sham stimulation.
- Dual tDCS added to feedback training may be beneficial for improving USN or general ADLs, compared to feedback training alone.
- The literature is limited and mixed regarding the effect of dual transcranial alternating current stimulation (tACS) for improving USN.
- Right- or left-sided, high- or low-intensity galvanic vestibular stimulation (GVS) may not be beneficial for improving USN or general ADLs compared to sham stimulation.
- Vestibular rehabilitation may not be beneficial for improving USN or general ADLs compared to conventional rehabilitation.

- Optokinetic stimulation added to visual scanning may be beneficial for improving USN compared to visual scanning alone.
- Optokinetic stimulation with or without eye patching may not be beneficial in improving USN, neglect-specific ADLs, or general ADLs compared to conventional neglect rehabilitation or usual care.
- Functional electric stimulation (FES) combined with prism adaptation may be beneficial for improving USN and neglect-specific ADLs when compared to either FES or prism adaptation alone.
- The evidence is mixed regarding the beneficial effect of dopaminergic medications compared to a placebo for improving USN.
- The literature is mixed for the effect of rivastigmine combined with cognitive rehabilitation on improving USN when compared to cognitive rehabilitation alone.
- The evidence is mixed for the effect of Nicotine patch treatment for improving USN when compared to placebo.
- The literature is mixed regarding the beneficial effect of guanfacine compared to placebo for improving USN.

Methodology

This chapter represents the 21st edition of “Chapter 13: Rehabilitation of Unilateral Spatial Neglect.” For a detailed description of the methodology, please refer to “Chapter 1: Introduction and Methods.” The Modified Sackett Scale version 4 is used for evidence level generation in this chapter.

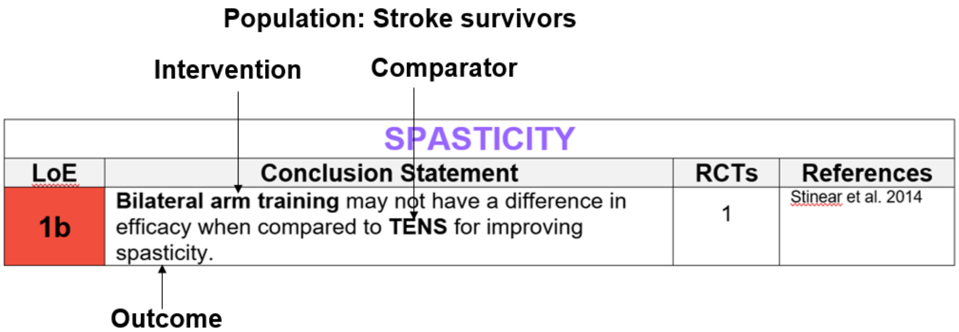
Modified Sackett Scale

Level of evidence	**Study design**	**Description**
Level 1a	Randomized controlled trial (RCT)	More than 1 higher quality RCT (PEDro score ≥6).
Level 1b	RCT	1 higher quality RCT (PEDro score ≥6).
Level 2	RCT	Lower quality RCT (PEDro score <6).
	Prospective controlled trial (PCT)	PCT (not randomized).
	Cohort	Prospective longitudinal study using at least 2 similar groups with one exposed to a particular condition.
Level 3	Case Control	A retrospective study comparing conditions, including historical cohorts.
Level 4	Pre-Post	A prospective trial with a baseline measure, intervention, and a post-test using a single group of subjects.
	Post-test	A prospective post-test with two or more groups (intervention followed by post-test and no re-test or baseline measurement) using a single group of subjects
	Case Series	A retrospective study usually collecting variables from a chart review.
Level 5	Observational	Study using cross-sectional analysis to interpret relations. Expert opinion without explicit critical appraisal, or based on physiology, biomechanics or "first principles".
	Case Report	Pre-post or case series involving one subject.

PICO Conclusion Statements

Neglect rehabilitation interventions synthesize study results from only randomized controlled trials (RCTs) with at least 50% of participants diagnosed with post-stroke USN, all levels of evidence (LoE) and conclusion statements are presented in the Population Intervention Comparator Outcome (PICO) format.

For example:

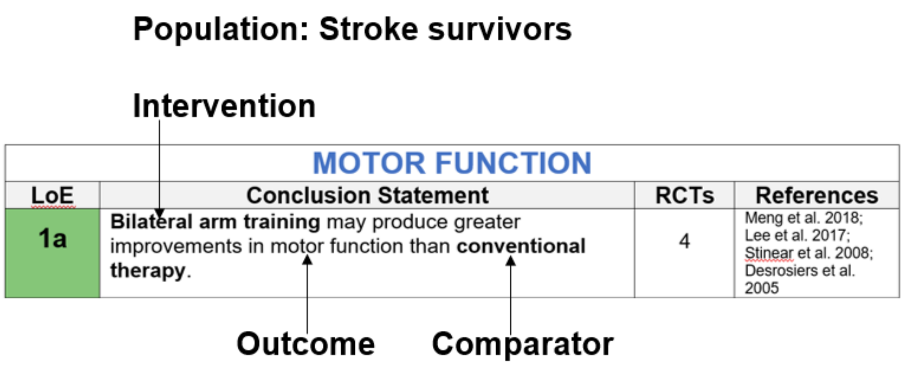


Similar to the previous version of this chapter, different colors are assigned to the conclusion statements where the levels of evidence are written.

Red statements like above, indicate that the majority of study results when grouped together show no significant differences between intervention and comparator groups.

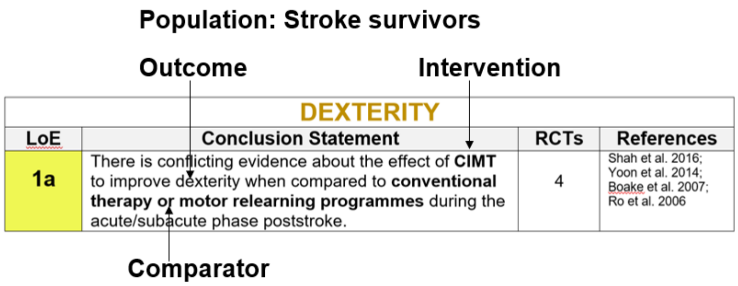
Green statements indicate that the majority of study results when grouped together show a significant between group difference in favour of the intervention group.

For example:



Yellow statements indicate that the study results when grouped together are mixed or conflicting, some studies show benefit in favour of the intervention group, while others show no difference between groups.

For example:



Neglect Rehabilitation Outcome Measures

For the purpose of this chapter, outcome measures relevant to USN and its functional and cognitive consequences were classified into four broad categories. Although included studies may have also reported additional outcome measures (e.g., motor or impairment-based assessments unrelated to neglect), such measures were not considered in the present classification, as they primarily reflect motor rehabilitation and recovery domains that are addressed in separate evidence review chapters available through EBRSR.com. These categories included:

Visuospatial Processing & Unilateral Spatial Neglect: These outcome measures assessed visuospatial processing and orientation to examine neglect severity.

Neglect-Specific Activities of Daily Living: These outcome measures assessed functional performance in ADLs specifically affected by neglect symptoms.

General Activities of Daily Living: These outcome measures assessed performance and level of independence in various everyday tasks.

Global Cognition: These outcome measures assessed an individual's overall cognitive processing capability factoring in multiple domains.

Outcome measures fitting these four categories include, but are not limited to, the following:

Outcome Measure Definitions

Visuospatial Processing & Unilateral Spatial Neglect

Albert's Test: Is a measure used to screen for USN in stroke patients. Lines are placed in random orientations on a piece of paper and participants are instructed to cross out the lines. Lines that are left uncrossed on the side corresponding to the participants motor deficit or lesion signify USN. It is scored by counting the number of uncrossed lines on each side. Albert's test has shown to have high correlation with Line Bisection Catherine Bergego Scale, Star Cancellation test and Wundt-Jastrow Illusion test as well as good test-retest reliability in detecting USN in stroke patients (Agrell et al., 1997; Azouvi, 1996; Fullerton et al., 1986; Massironi et al., 1988).

Auditory Subjective Median Plane (Midline): is a test of auditory sound localization. Participants are exposed to a binaural white noise stimulus for 3 seconds via headphones. The headphones manipulate different aspects of the auditory stimuli so that they have a different perceived source location. Participants responded in a binary (yes/no) manner as to whether they perceived the sound to be originating from their median pane, or if it was to the left or right. Mean deviation from center was used to assess neglect (Kerkhoff et al., 2006).

Balloons Test: See Bell's Test. Balloons test is a measure of visual inattention. It is a cancellation task similar to Bell's Test. The test has 2 parts: 1) a search of 20 "balloons" (circle with straight line attached) among a much larger number of circles; and 2) a search of 20 circles among a much larger number of "balloons" (Diesfeldt, 2012).

Barrage test: See Albert's test. This test is another name for Albert's test but will sometimes contain fewer lines than the original when it is described in the literature (Paolucci et al., 1996).

Behavioural Inattention Test (BIT): Is a battery of tests intended to evaluate the presence and severity of visual neglect. It consists of two subtests, a 'conventional subtest' and a 'behavioural subtest'. The conventional subtest consists of 6 items (e.g. Line crossing, letter cancellation, etc.). The behavioural subtest consists of 9- items that are functional activities as opposed to standardized neglect tests (e.g. telephone dialing, map navigation, etc.). A maximum score for the BIT, the conventional subtest and the behavioural subtests are 227, 146 and 81 respectively, with higher scores indicating more severe impairment. The scale proven to have good test- retest validity and accurately predicts poor functional outcomes in stroke (Jehkonen et al., 2000; Wilson et al., 1987).

Bell's Test: Is a type of cancellation task used to measure visual neglect. Subjects are asked to scan a sheet with 7 columns of drawn stimuli and cross out all target stimuli (i.e. bells). The pattern of scanning can be evaluated as well as the distribution of targets that the subject omits. From this, the pattern and degree of neglect can be determined (Gauthier et al., 1989).

Center of Cancellation: Allows neglect severity to be evaluated from cancellation tasks, such as the Letter Cancellation test or Bell's test. Using a computer program, participant's responses are recorded and the mean horizontal coordinate for detected items is calculated (Rorden & Karnath, 2010).

Clock Drawing Test: Is a very brief screening tool used to detect cognitive impairment. It can also detect neglect and executive dysfunction. Participants are asked to draw a clock along with numbers and hands denoting a specified time. There are multiple different rating systems, with most classifying the number and type of errors made. The test is valid and reliable as a screening tool, with a high sensitivity and specificity (Duro et al., 2018; Sheehan, 2012).

Cued Detection Task (Posner Cueing Task): is a test often used to assess attention. Participants are instructed to look at a fixation point in the middle of the screen, and two target areas lie on either side. The participant is instructed to respond once they have detected a stimulus in one of the target areas. During the test, visual cues will precede the stimuli and either cue the participants in the correct direction of stimuli appearance, or the incorrect direction. Individuals with Neglect will be differentially affected by the cueing (Vossel et al., 2010).

Dichotic Listening Task: is used to assess lateralized auditory perception. Pairs of stimuli are presented to the participant, one in the left ear and one in the right. The participant is instructed to focus on both stimuli, and to repeat them after presentation. Scores are based around the percentage of stimuli identified correctly in both the right ear and left ear separately (Hugdahl et al., 1991).

Extinction Task: is used to assess visuospatial memory and neglect. Visually presented images are shown in either the right hemifield or the left hemifield, and recall is assessed separately for each hemifield. Any bias in visual memory to one side might indicate USN (Vaes et al., 2018).

Fluff Test: This is a measure of personal domain in neglect syndrome. The participant is blindfolded and 24 targets are placed on their body. They are kept distracted during the placing of the targets (to prevent counting) and then asked to remove all the pads from their body. Scoring is based on omissions of targets from the left side. This test has demonstrated high test-retest reliability (Cocchini et al., 2001).

Functional Neglect Index: was a battery devised for a specific study, and consists of a reaching/finding objects task, a picture search task, a stick bisection (line bisection) and a gaze orientation. Each task was rated on a scale from 0-3 and scores were summed, with a higher overall score indicating more severe impairment (Kerkhoff et al., 2014).

Grey Scales: Is a measure used to quantify orienting of visual attention, in which participants are presented with a set of 26 items. Each item is a A4 piece of paper with two rectangles containing semi-continuous shades of grey ranging from black to white at the ends. The two rectangles are identical, but the mirror reverse of one another. The items thus have two grey scales, lying horizontally, one on top of the other. The participant is asked to decide which scale is darker, the top or the bottom (Tant et al., 2002).

Hand Judgement Test: Is a test of the ability of an individual to use mental transformations to identify right and left hands. This test involves line drawings of hands presented to the participant as a palm or the back of a hand in different six planes. The participants are then required to decide if the image is of a right or left hand. Their own hands are not visible during the task (Cooper & Shepard, 1975; Reinhart et al., 2012).

Harrington-Flocks Visual Screener: This screening assessment is used to assess any visual field deficits. The test consists of 9 different patterns, each of which is designed to detect a visual field deficit in various locations. The pattern is in fluorescent ink. While the participant stares at a fixation point, a black light is shone on the card for 0.2-0.3 seconds before being turned off. At the point, the participant reports what they have seen. Scores are based on the number of targets missed within the affected field (Harrington & Flocks, 1954).

Joint Position Sense Test (JPST): Is a measure of how well stroke survivors can perceive the position of their joints in motion and standing still. The measure consists of 1 functional task repeated several times. This task involves the patient holding 2 different shaped objects that also weigh different from each other and then told to identify which one weighs more and which one has a stranger shape. The more times the patient (s) identifies which shape is heavier/unique, then the better the outcome. This measure has been shown to have good reliability and validity (Kattenstroth et al., 2013).

Judgement of Drawing of Two Houses: Used to investigate blindsight and insight as well as in cases of visual neglect. The participant is presented with two identical drawings of a house differing only by the presence of red flames on the left side of one of the houses. They are then asked to make a same- different judgement (Rusconi et al., 2002).

King Devick Test (Subtests 1,2,3): is a number of tasks that is generally carried out to quickly assess whether an individual has had a concussion. The first 3 tasks, however, are related to visual perception and processing. In each of the first three tasks, there are numbers placed on a page, with each task having a different, and progressively more complicated pattern. The participant is asked to read the numbers out loud from left to right as quickly as possible. Time, and errors made are used to assess task performance (Subotic et al., 2017).

Landmark Test: The purpose of the Landmark test is to differentiate between perceptual and motor-based errors made in the line bisection test in spatial neglect patients. In this test participants are presented with lines that are pre-bisected (with the landmark) centrally or asymmetrically to either the left or the right. Each line is presented in three spatial locations relative to the participant's midline (right, middle, left). They were informed that none of the lines were bisected medially and then required to point to the end of line that appeared to be closer to the landmark. Socring is based on the proportion of left and right judgements, particularly on the centrally located landmarks (Harvey et al., 1995).

Lane Tracking Task: is a driving simulation task, whereby patients are instructed to maintain a position on the road, while 'sidewind' blows them off course. Patients must counteract these perturbations in either direction to maintain the proper position on the road. Mean lateral position and standard deviation are used to reflect their position on track and relative degree of oscillation (van Kessel et al., 2013).

Line Cancellation (Line Bisection) Test: see Bell's Test. AKA Schenkenberg Test. The line cancellation test is another version of a cancellation task used to detect the presence of neglect in stroke. Subjects are asked to cross out lines on a page filled with lines of various orientations. If lines are consistently crossed out closer to one side of each line than another, this can be interpreted as evidence of USN. Any areas on the page where lines have failed to be crossed can also be used to evaluate neglect (Schenkenberg et al., 1980).

Line Crossing Test: See Line Bisection Test. This is a gamified version of the Line Bisection test.

Motor-Free Visual Perception Test (MVPT): Is a measure of visual- perceptual ability independent of motor ability. Spatial relationships, visual discrimination, figure-ground, visual closure and visual memory are assessed. A total raw score is obtained based on the number of correct responses and standard score, percentile rank and age-equivalent score are generated. In the current version (MVPT-4), the test contains 45 items. The MVPT exhibits acceptable construct, content and criterion validity as well as good test-retest reliability and internal consistency (Brown & Peres, 2018).

Munich Reading Texts: Is one standardized version of reading task. There are six 180-word long paragraphs that are designed with simple linguistic structure and relatively short sentences. The task involves reading the text out loud as as quickly and accurately as possible. Any errors or omissions on the left or right side of the paragraph are counted and used to score the test (Kerkhoff et al., 1992).

Neale Analysis of Reading Ability: Is a measure of reading accuracy and comprehension through an orally read text. Participants are required to read a text appropriate to their level and accuracy scores are calculated based on the number of errors made during the reading.

Comprehension questions are then asked to evaluate the participants understanding of the text they read (Neale, 1997).

Ogden Figure Copying Task: is a visuomotor figure copying task used to assess neglect. The figure is a small line drawing scene that consists of a (from left to right) a tree, a fence, a house and a different tree. Subjects are asked to copy down the drawing, and any errors or distortions based on the left and right side of the photo are noted and used to assess neglect (Ogden, 1985).

Orientation Lines Test: is designed to assess visuospatial judgement. A test card is presented with 2 lines placed in various locations, and of different orientations. A reference card is provided, that displays 11 numbered lines all with different orientations. The patient must identify which angle the test card lines are, using the numbered reference line with the same angle. This has been shown as a sensitive measure for those suffering from unilateral brain damage (Benton et al., 1978).

Ota's Task: is an assessment that is designed to distinguish between object-centered and body-centered forms of neglect. The task consists of 2 tests of similar nature. The first involves a piece of paper with 40 circles distributed randomly on the page. Some of these circles are incomplete, with missing sections either on the right side or the left. The second task involves 40 triangles on a page, also with some of the triangles missing sections on either the right side or the left. Participants are asked to circle the complete shapes and cross out the incomplete ones. Scoring is based on two variables. One is the number of shapes incorrectly chosen on each side of the paper, and the other is the number of shapes incorrectly chosen which were incomplete on the left side, versus those incomplete on the right (Ota et al., 2001).

Quadruplet Detection Task: Used to assess visual detection across hemifields, this measure requires participants to detect a coloured shape in one of four quadrants from 3 black shapes. It assesses visual neglect based on response latencies and/or detection rate in regions of the visual field (Lucas et al., 2013; Vuilleumier & Rafal, 2000).

Real Objects Test: Is a measure of visual neglect based off the Line Bisection test but using everyday objects. The test requires participants to reach for an everyday object (rolling pin, towel rail) in the center. Deviations from the center are used to test for the presence of visual neglect (Harvey et al., 2003; Robertson et al., 1997).

Rey-Osterrieth Complex Figure Test: Is a measure of visuo-spatial abilities and visual memory. The test requires the subject to copy a complex geometrical figure and, after an interval, reproduce the figure from memory without forewarning. The most used method of scoring the test is the Osterrieth method, a scoring system that provides a 36-point summary score based to the presence and accuracy of 18 units of the figure. The test has been shown to have excellent interrater reliability and good discriminant validity (Salvadori et al., 2019).

Rivermead Perceptual Assessment Battery: consists of 16 different subtests, which can be divided into 8 different categories (form constancy, body image, cube copying, sequencing, object copying, figure ground, inattention and spatial awareness). It has been shown to have good inter-rater reliability, and correlates well with other psychological and behavioural assessment of visual perception (Lincoln & Edmans, 1989).

Sentence Reading Test: A measure of visual spatial neglect, in which participants are required to read 6 sentences aloud. Scores are based on number of sentences read without omissions (Paolucci et al., 1996).

Single and Double-digit Cancellation: See Letter Cancellation Test. A target number (between 1 and 9) is randomly intermixed, with an even number of digits on the left and right side, with distractor numbers between 1 and 9. The participant is required to cross out all the occurrences of the target number. Scores are calculated based on the number of targets omitted in the right and left hemifields. The same procedure is followed for double- digit cancellation, however, the participant is given two numbers as targets (i.e. 3 and 6) (Kerkhoff et al., 2013).

Tangent Screen Exam: is a comprehensive assay of an individual's visual field. It requires the participant to focus on the center of a screen, while targets are presented in their periphery. Participants will inform the assessor when they are able to see the target. Using this information, a detailed map of the visual field can be produced, and any deficits identified (West, 1988).

Target Cancellation: See Bell's Test. This is a measure of spatial neglect, in which the participant is required to circle targets that have been mixed in with distractors in 7 columns on sheet of paper. The angular gyrus is critical for task performance. This measure has been found to correlate highly with the Line Bisection test but is more sensitive (Gauthier et al., 1989; Molenberghs & Sale, 2011).

Testing Battery for Attentional Performance: is a series of tests developed to assess all facets of attentional processing. The computerized testing consists of 13 sub-tests (eg. Alertness, Eye Movements, Working Memory etc…) that assess various components of cognition and behaviour related to attention (Zimmermann & Fimm, 2004).

Verbal Cancellation Test (Letter Cancelation): is another form of cancellation test (see Ballon's and Bell's Tests). This one however uses letters and other 'verbal' stimuli as opposed to non-verbal symbols (Brucki & Nitrini, 2008).

Vienna Test System – Peripheral Perception: is an assessment of peripheral perception, included in the neuropsychological test and training program "Vienna Test System Neuro". The test is a modified tangent screen test, where an individual is asked to track a target on a computer screen while lights are flashed in different peripheral locations. The participant then identifies when they have seen a peripheral stimulus (Cazzoli et al., 2012).

Visual Scanning Tasks: can take on many forms but comprise of the same basic principles. Often a photo or a group of symbols is used. In this task, the individual is asked to identify certain target stimuli or objects within an image, and the number of stimuli omitted on either side of the photo are used to assess neglect (Cazzoli et al., 2012).

Visual Subjective Straight Ahead: is a task used to assess neglect. It involves a luminous rod that patients are instructed to translate and rotate to align it with the longitudinal midline axis of the head and body (Saj et al., 2006).

Wundt- Jastrow Illusion Test: Used for detection of USN, this test has 40 differing stimuli consisting of two fans identical in shape and surface. Each of the pairs of fans has one of two orientations (right or left direction and upward or downward convexity). The participant is the required to indicate which of the two fans is larger, the top or the bottom (Massironi et al., 1988).

Neglect- Specific Activities of Daily Living

Catherine Bergego Scale: Is a 10-item measure of functioning in everyday tasks used to assess USN in stroke patients and anosognosia. A rater will score the patient on a 4-point scale (0 = no neglect, 3 = severe neglect) for each of the items, for example "Forgets to groom or shave left part of his/her face" (Item 1). There is a total score of 30, with higher scores corresponding to greater levels of impairment. The scale has proven to be both reliable and valid in assessing neglect and anosognosia (Azouvi, 1996; Azouvi et al., 2003).

Baking Tray Task: Is an ecological measure used to detect USN. In the test participants are instructed to spread 16 cubes along a 75 x 100cm board as evenly as possible, like "lying out buns on a baking tray". There is no fixed time limit, and it is scored by counting the number of cubes on each half of the tray. Half points are awarded if the cube sits on the midline. This measure has proven to be sensitive in detecting neglect and resistant to practice and set effects. It has been found to have high correlation with the Line Bisection test (Appelros et al., 2004; Bailey et al., 2004; Tham, 1996).

Coin Sorting: Is a test of neglect, whereby coins of different values are distributed to the left, in front, and to the right of the patient based on a standard arrangement. They are then asked to indicate all the coins with a particular value. Any omissions are recorded along with the side that the coin was located on (Halligan et al., 1991).

Comb and Razor Test: Is a clinical test for personal neglect (neglect of personal space), in which the participant is given a comb and a razor (or powder compact case for women) and instructed to comb their hair or shave/apply makeup on their face. The number of strokes within 30 seconds are categorized into left, ambiguous or right strokes. The score is most often calculated based on the percent bias of strokes to a particular side. Scores fall anywhere between -1 (total left neglect) and +1 (total right neglect). The test has proven to be highly reliable and be able to distinguish between different known groups of participants (right or left-brain stroke, healthy individuals, extra personal neglect) (Beschin & Robertson, 1997).

Kessler Foundation Neglect Assessment (KF-NAP): Is a standardized administration and scoring method of the Catherine Bergego Scale used to evaluate USN during ADLs following stroke. KF-NAP was developed to improve the reliability and consistency of CBS administration through structured observation and standardized scoring procedures (Chen et al., 2012).

Mobility Assessment Course: is an active assessment of neglect. Individuals are instructed to walk or navigate a wheelchair down a corridor without stopping. While navigating the corridor, patients had to point out marked targets that were set long their path. There is no time limit, and scores are computed as the difference between left and right omissions (Ten Brink et al., 2017).

Subjective Neglect Questionnaire: Is a questionnaire for detecting everyday problems typical of individuals with USN. Participants are asked to rate the frequency of 19- neglect related issues, such as bumping into furniture, telling time or navigating wheelchair, occurring within the past month. The questionnaire has been found to correlate with the star cancellation test significantly.

However, neglect participants have often been found to rate their experiences differently from their relatives (Towle & Lincoln, 1991).

Semi-structured Scale for the Functional Evaluation of Hemi-attention: Used to functionally evaluate hemineglect, this scale includes two subscales corresponding to extra-personal space and personal space. Extra-personal space tasks include serving tea, dealing cards to four people sitting round a square table, describing three complex pictures, and describing a room. Personal space tasks include use of everyday objects: razor or make-up, comb, glasses. Items are scored from 0 (normal) -3 (severe). Inter- rater reliability has been reported as good (Azouvi, 1996; Zoccolotti & Judica, 1991).

Unawareness and Behavioural Neglect Index: See Catherine Bergego Scale. This measure is based off the Catherine Bergego Scale but also contains six measures intended to evaluate level of awareness in daily life. It is a 10- item scale with the remaining four measures of behavioural neglect in ADLs. The index is measured on a four- point scale (0 behavior never occurs – 3 behaviour occurs daily) (Kerkhoff et al., 2014).

General Activities of Daily Living

Activities of Daily Living Questionnaire: consists of 30 items which can be grouped into 6 subscales based on the type of problem (personal care, reaching, grasping, spatial orientation, time orientation, awareness of the deficit). Answers were recorded by a family member or hospital staff, and each item was rated on a scale from 0-3, where higher scores indicated greater levels of impairment. This Questionnaire was a modified and extended version Towle and Lincoln's questionnaire (see Subjective Neglect Questionnaire) (Schindler et al., 2002).

Barthel Index (BI): Is a measure of one's ability to perform ADLs. The scale consists of 10 items: personal hygiene, bathing, feeding, toilet use, stair climbing, dressing, bowel control, bladder control, ambulation or wheelchair mobility and chair/bed transfers. Each item has a five-stage scoring system and a maximum score of 100 points, where higher scores indicate better performance. The scale is suitable for monitoring on the phone and is shown to have a high inter-rater reliability (Park, 2018).

Functional Independence Measure (FIM): Is an 18-item outcome measure composed of both cognitive (5-items) and motor (13-items) subscales. Each item assesses the level of assistance required to complete an activity of daily living on a 7-point scale. The summation of all the item scores ranges from 18 to 126, with higher scores being indicative of greater functional independence. This measure has been shown to have excellent reliability and concurrent validity in its full form (Granger et al., 1993; Granger et al., 1998; Linacre et al., 1994).

Help Index (Help Scale): A measure of stroke patients' functionality in ADLs. Participants perform 10 ADLs and are rated by a nurse on a scale from one (no help needed) to five (fully reliant on nurse for completion of task). Items are as follows: 1. Correct arm placing, 2. Correct leg placing. 3. Dressing. 4. Shaving/combing. 5. Orienting in the rehabilitation ward. 6. Orienting in the patient's room. 7. Eating. 8. Putting on glasses. 9. Finding persons or objects in the room. 10. Transfers from bed to chair and back (Kerkhoff et al., 2014).

Global Cognition

Mini Mental Status Examination (MMSE): Is a brief screening tool and quantitative assessment of cognitive impairment. It is one of the most commonly used instruments for this purpose. The exam consists of 11 questions/tasks in 7 cognitive domains: 1) orientation to time; 2) orientation to place; 3) registration of 3 words; 4) attention and calculation; 5) recall of 3 words; 6) language; and 7) visual construction. The test is scored out of 30 possible points, with a score of 18-24 denoting mild impairment and a score of 0-17 denoting severe impairment. The test has been found to be valid as a screening tool, and is sensitive for detecting moderate/severe impairment, but not mild impairment. It has good interrater reliability. The MMSE is appropriate for screening for post-stroke cognitive impairment (Bour et al., 2010; Dick et al., 1984; Tombaugh & McIntyre, 1992).

Ravens Coloured Progressive Matrices: is a measure of intelligence that consists of a series of multiple-choice items of abstract reasoning. Each item depicts an abstract pattern in a two by two or three by three matrix; all cells contain a figure except for one cell in the corner. Participants are asked to identify the missing segment that would best complete the pattern. The test is shown to be a reliable measure of visuo-perceptual, and memory cognitive functioning in persons with motor impairment and speech deficits (Brouwers et al., 2009; Pueyo et al., 2008).

Wechsler Adult Intelligence Scale (WAIS): Is a widely used IQ test designed to measure a person's intelligence and cognitive ability. The original WAIS was created in 1955, and there have been many revisions since, including the WAIS-R, WAIS-III, and WAIS-IV. WAIS-R is a revised form of the WAIS and consists of six verbal (information, comprehension, arithmetic, digit span, similarities, vocabulary) and five performance (picture arrangement, picture completion, block design, object assembly, digit symbol) subtests. The current edition, WAIS-IV, includes four core indices measuring verbal comprehension, perceptual reasoning, working memory, and processing speed. The WAIS scales have long been considered the gold standard measure of intellectual functioning and have demonstrated excellent validity and reliability (Denhart, 2018).

Corsi Vertical Span Test: is a measure designed to assess memory independently from USN. It is a measure of short-term visuospatial and working memory. The examiner taps a series of blocks in succession, one at a time, then the participant is asked to tap the blocks either in the same sequence (forward test) or in reverse (backward test). Backwards tests are thought to involve executive function to a greater degree. The test can also be computerized. The 'vertical' aspect simply means the blocks are aligned vertically on the participants midline, so as to prevent USN from affecting the results. This test can also be computerized. Span tests have shown to be valid assessments of working memory and are specific, however their sensitivity and symptom validity are variable (Berch et al., 1998; Wentink et al., 2016).

Defining Neglect

Unilateral spatial neglect (USN) is one of the most disabling cognitive-perceptual consequences of a stroke, and is classically defined as a failure to report, respond, or orient to sensory stimuli presented in contralesional space following brain injury, which cannot be explained by primary sensory or motor deficits (Rode et al., 2017; Williams et al., 2021). Originally described by Heilman and colleagues, USN is now understood as a heterogeneous disorder involving impaired spatial attention and awareness across multiple sensory and motor domains (Heilman et al., 1984; Watson et al., 1978).

Several terms have historically been used interchangeably in the literature, including unilateral neglect, hemispatial neglect, hemi-inattention, and visual neglect. However, the term “visual neglect” may be misleading, as neglect can involve visual, auditory, tactile, motor, and representational domains rather than vision alone (Rode et al., 2017; Williams et al., 2021).

Clinically, severe USN may be apparent when individuals collide with objects, ignore food on one side of a plate, fail to attend to one side of their body, or demonstrate unsafe mobility and impaired awareness of the environment (Durfee & Hillis, 2023; Williams et al., 2021; Wyness, 1985). More subtle forms may become evident only during complex activities such as community mobility, driving, work, or social interaction. Even mild neglect may significantly affect safety, independence, rehabilitation outcomes, and quality of life (Durfee & Hillis, 2023; Mesulam, 1999; Williams et al., 2021).

USN is highly heterogeneous and may be classified according to spatial reference frame or spatial domain. In terms of reference frame, neglect may be:

- **Egocentric neglect (viewer/body-centered):** impaired attention toward the contralesional side relative to the patient’s body midline.
- **Allocentric neglect (object-centered):** impaired attention toward the contralesional side of individual objects regardless of their location in space (Demeyere & Gillebert, 2019).

Neglect may also affect different regions of space:

- **Personal neglect:** neglect involving the patient’s own body.
- **Peripersonal neglect:** neglect within reaching distance.
- **Extrapersonal neglect:** neglect affecting far space beyond reaching distance.

These neglect subtypes may occur independently or in combination within the same individual (Rode et al., 2017; Williams et al., 2021).

Incidence of Neglect

Reported prevalence rates of USN following stroke vary considerably depending on the assessment method, definition of neglect, lesion location, and time since stroke (Bowen et al., 1999). Earlier studies reported prevalence rates ranging widely across populations and settings. More contemporary evidence suggests that USN occurs in approximately 25- 30% of stroke survivors (Durfee & Hillis, 2023; Esposito et al., 2021; Mehrabi et al., 2026).

Neglect occurs more commonly and more severely following right hemisphere stroke, although left hemisphere neglect can also occur. Neglect is most frequently observed during the acute phase after stroke, with many individuals demonstrating partial recovery over the first weeks and months. Nevertheless, persistent neglect remains common and is associated with poorer functional outcomes, reduced independence in ADLs, impaired mobility, increased fall risk, longer hospital stays, and reduced likelihood of community reintegration (Durfee & Hillis, 2023).

The presence and severity of neglect have been associated with larger stroke severity, older age, cognitive impairment, and right hemisphere lesions. Neglect frequently coexists with other cognitive and perceptual impairments, including deficits in attention, executive function, visual field impairment, and apraxia (Williams et al., 2021).

Anatomical Substrates of Neglect

USN occurs more commonly and often more severely following right hemisphere stroke than left hemisphere stroke. In the Copenhagen Stroke Study (Pedersen et al., 1997), 42% of individuals with a right-sided lesion were reported to have USN compared to only 8% of patients with a left hemisphere lesion. Similar findings have been reported in subsequent large stroke cohorts, with neglect demonstrating greater persistence following right hemisphere injury (Ringman et al., 2004).

Early models of neglect proposed that the right hemisphere plays a dominant role in mediating spatial attention toward both sides of extrapersonal space, whereas the left hemisphere primarily directs attention toward the contralateral right hemispace. This hemispheric asymmetry was proposed to explain why neglect is more common and severe following right hemisphere damage (Figure 1), (Feinberg et al., 1990).

More contemporary models conceptualize USN as a disorder of distributed attentional networks rather than damage to a single cortical region. Neuroimaging and lesion-network studies have implicated dysfunction within frontoparietal attention systems, including the dorsal and ventral attention networks, particularly within the right hemisphere (Corbetta et al., 2005; Corbetta & Shulman, 2011). Lesions involving the inferior parietal lobule, temporoparietal junction, frontal cortex, superior temporal gyrus, and associated white matter pathways such as the superior longitudinal fasciculus have all been associated with neglect (Karnath & Rorden, 2012). More severe and persistent neglect has been associated with large right middle cerebral artery infarcts involving frontal, temporal, and parietal cortical regions (Ferro et al., 1999; Paolucci et al., 2001).

Although neglect is less common following left hemisphere stroke, it may be underrecognized due to coexisting aphasia and is increasingly acknowledged as clinically relevant (Williams et al., 2021).

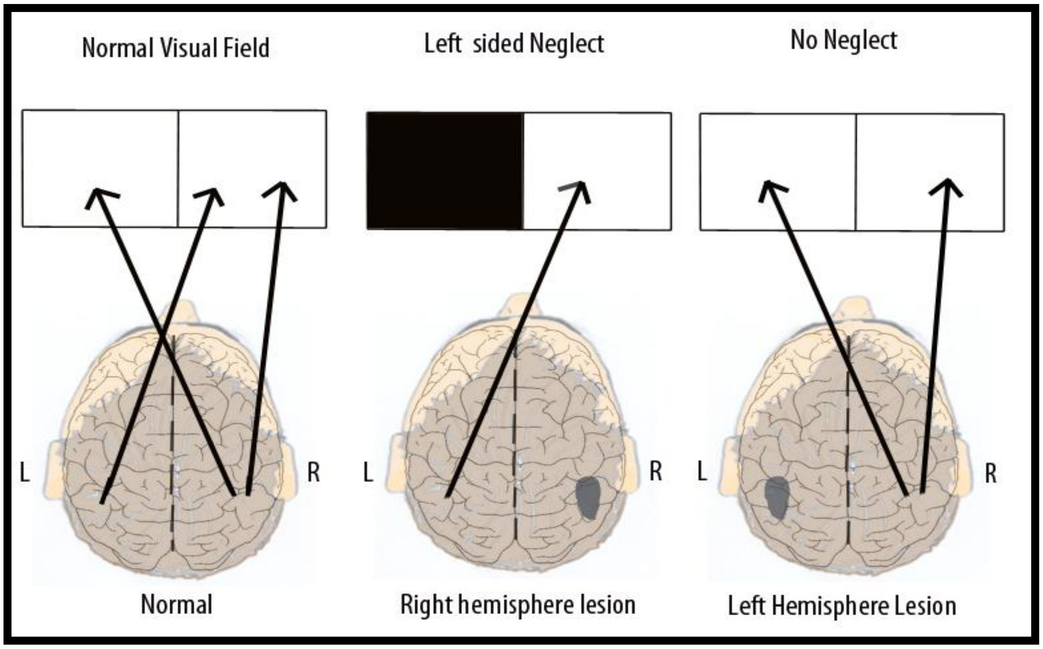


Figure 1. This illustration represents the classic hemispheric asymmetry model of spatial attention. Contemporary models conceptualize neglect as a disorder of distributed attentional networks, and neglect may also occur following left hemisphere lesions.

Spontaneous Recovery and Neglect

The prevalence and severity of USN generally decline over time following stroke, with the greatest degree of recovery typically occurring during the acute and subacute phases. Earlier longitudinal studies demonstrated that the most prominent manifestations of neglect often improve substantially within the first weeks after stroke onset (Ferro et al., 1999; Katz et al., 1999; Paolucci et al., 2001). However, recovery trajectories are highly variable, and persistent neglect may continue into the chronic stage in a substantial proportion of individuals (Corbetta et al., 2005; Durfee & Hillis, 2023).

Persistent neglect has been associated with poorer functional recovery, impaired mobility, reduced independence in ADLs, and decreased community reintegration (Durfee & Hillis, 2023). Although improvements may continue beyond the first months after stroke, recovery generally slows over time, with the largest gains typically observed early after stroke onset (Corbetta et al., 2005).

Recovery may also differ according to neglect subtype. Appelros et al. demonstrated that patients with peripersonal neglect experienced complete recovery less frequently than patients with personal or extrapersonal neglect. By 6 months post-stroke, complete recovery was observed in 52% of patients with extrapersonal neglect and 46% of those with personal neglect, compared with only 13% of patients with peripersonal neglect (Appelros et al., 2004). Although recovery tended to plateau after 6 months, some individuals may continue to demonstrate improvements during the chronic phase (Durfee & Hillis, 2023).

The Impact of Neglect Post Stroke

USN is associated with significant negative effects on post-stroke recovery and functional independence. Numerous studies have demonstrated that neglect adversely affects mobility, balance, ADLs, rehabilitation participation, and community reintegration, and is associated with longer rehabilitation stays and increased likelihood of institutionalization following discharge (Durfee & Hillis, 2023; Gillen et al., 2005; Paolucci et al., 2001).

Although many patients demonstrate substantial improvement during the first weeks and months after stroke, individuals with more severe neglect at initial presentation generally experience poorer functional outcomes and slower recovery trajectories (Diamond & rehabilitation, 2001; Durfee & Hillis, 2023). Persistent neglect has also been associated with increased fall risk, impaired safety awareness, reduced independence, and decreased quality of life (Durfee & Hillis, 2023).

Patients with USN often demonstrate greater functional impairment at rehabilitation admission compared with patients without neglect, particularly when both personal and extrapersonal neglect are present (Katz et al., 1999; Wee et al., 2008). Although substantial functional gains may occur during rehabilitation, patients with neglect generally continue to demonstrate greater disability at discharge (Timbeck et al., 2013; Wee et al., 2008).

The coexistence of personal and spatial neglect has been associated with increased safety concerns, including collisions with objects or people, impaired awareness of the contralesional side, reduced insight into deficits, and greater risk of injury (Wee et al., 2008). In addition, neglect has been associated with longer rehabilitation length of stay, lower Functional Independence Measure (FIM) scores at both admission and discharge, reduced likelihood of discharge home, and increased risk of secondary complications such as shoulder and upper extremity injury (Wee et al., 2008).

USN has consistently been identified as a major predictor of functional dependence following stroke. The presence of neglect has been associated with poorer performance in both ADLs and instrumental ADLs during both the subacute and chronic stages of recovery (Jehkonen et al., 2000; Katz et al., 1999). Longitudinal studies have demonstrated that neglect is associated with persistent disability, reduced community independence, and increased need for assistance following discharge from rehabilitation (Jehkonen et al., 2000).

In addition to its impact on functional independence, USN has been associated with increased mortality, greater dependency, higher rates of institutionalization, and increased need for home assistance following stroke Contemporary evidence further supports neglect as an important determinant of reduced quality of life, impaired community reintegration, and long-term disability after stroke (Durfee & Hillis, 2023; Katz et al., 1999; Paolucci et al., 2001).

Although some earlier studies reported weaker associations between neglect and functional outcomes (Pedersen et al., 1997), subsequent reviews have consistently identified neglect as a significant predictor of poorer rehabilitation outcomes (Jehkonen et al., 2006). Variability across studies has been attributed to differences in patient selection, timing of assessment, definitions of neglect, outcome measures used, and the presence of coexisting impairments such as anosognosia, stroke severity, and hemiparesis (Jehkonen et al., 2006). More recent literature continues to emphasize the heterogeneous nature of neglect and the importance of comprehensive assessment across neglect subtypes and functional domains (Williams et al., 2021).

Language impairments in individuals with left hemisphere damage (LHD) following stroke may influence the validity of neglect assessments that rely on receptive or expressive language. As a result, patients with aphasia are frequently excluded from studies evaluating USN, which may contribute to an underestimation of neglect prevalence in this population. Early studies demonstrated that when individuals without aphasia were assessed, a substantial proportion of patients with LHD were identified as having neglect; however, when individuals with aphasia were included, the proportion screening positive for neglect increased markedly (Barer et al., 1990).

These findings suggest that language-dependent assessment tools may confound the evaluation of neglect in patients with aphasia and highlight the importance of using appropriate assessment methods in this population. This highlights the need for assessment tools that minimize language demands and capture neglect across multiple sensory modalities and functional contexts. More recent literature supports the view that USN following left hemisphere stroke may be underrecognized due to both assessment limitations and the masking effects of language deficits (Williams et al., 2021).

Although USN is more commonly associated with right hemisphere stroke, these findings emphasize that neglect can occur following lesions in either hemisphere. Therefore, all patients with stroke may benefit from appropriate screening for USN.

Screening and Assessments for Neglect

Clinicians are responsible for systematically screening all patients with stroke for USN as part of routine clinical assessment. Stroke guidelines emphasize the importance of screening all individuals with stroke for early identification of cognitive and perceptual impairments, including neglect, to inform rehabilitation planning and improve outcomes (Canadian Stroke Best Practice Recommendations, 2022). Current best practice recommendations suggest that screening for neglect and other cognitive deficits should be performed early in the acute phase as part of the routine neurological examination within 48 hours of regaining consciousness post-stroke and repeated as needed throughout the rehabilitation process (Intercollegiate Stroke Working Party, 2012).

Screening and assessment of USN may be conducted using pen-and-paper tests, observation of behaviour during functional activities, or a combination of both. Given the heterogeneous nature of neglect, including differences in spatial reference frames (e.g., egocentric vs allocentric) and affected domains, no single test is sufficient to detect all forms of neglect. Therefore, the use of multiple assessment tools/battery is recommended to improve sensitivity and ensure comprehensive evaluation (Parton et al., 2004; Williams et al., 2021).

Clinicians have the responsibility to systematically screen all clients for cognitive impairments and disabilities post stroke, including USN, with the use of standardized assessment tools and stroke scales (Agency for Health Care Policy and Research, 1994; Intercollegiate Stroke Working Party, 2012; Kelly-Hayes et al., 1998; Management of Stroke Rehabilitation Working Group, 2010).

A wide range of standardized and non-standardized tools are available to assess neglect across impairment and functional levels. Common pen-and-paper screening tools include the Line Bisection Test and various cancellation tasks, such as the Line Cancellation Test, Bells Test, Star Cancellation Test, and Mesulam Shape Cancellation Test (Parton et al., 2004). These tasks are quick to administer and widely used in clinical and research settings; however, they primarily assess visual and peripersonal neglect and may fail to detect more subtle or functionally relevant forms of neglect.

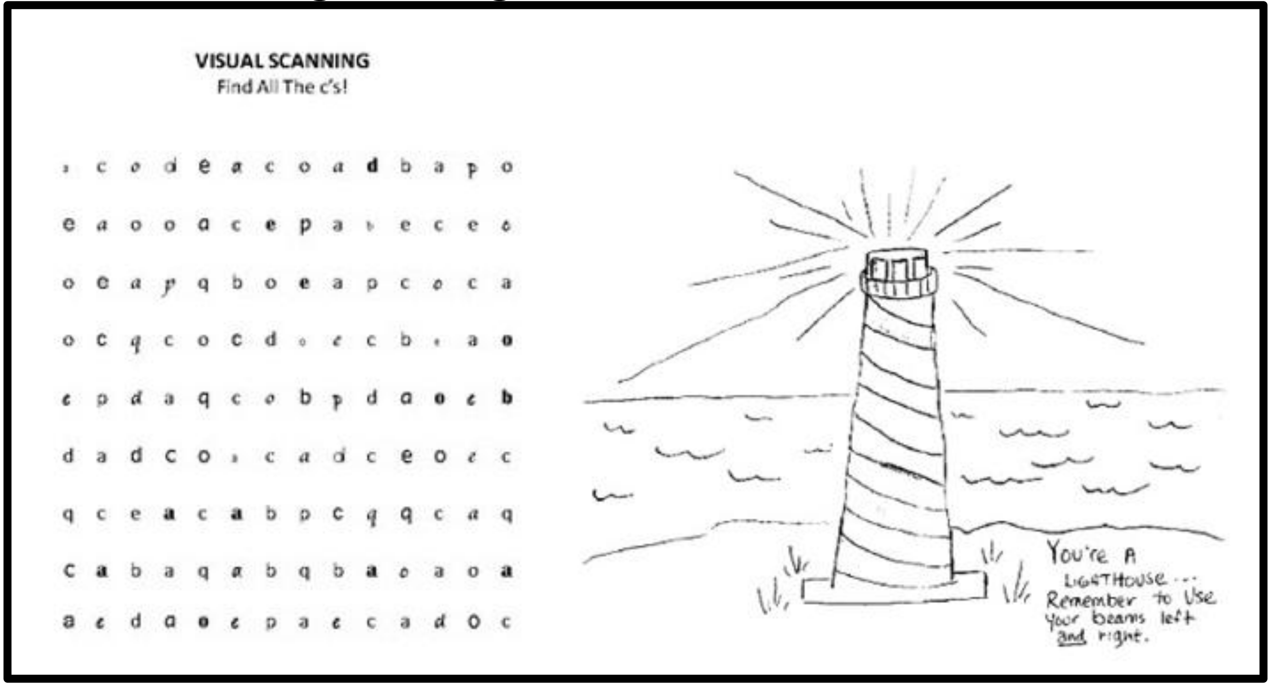
Behavioural and functional assessments are also essential for evaluating neglect in real-world contexts. Observational tools assess neglect in personal and extrapersonal space through performance of everyday activities, such as grooming or eating. Examples include the Comb and Razor Test and the Catherine Bergego Scale, which evaluates neglect during ADLs (Azouvi et al., 2003). These tools provide greater ecological validity and may detect deficits not captured by traditional paper-based tests.

More comprehensive assessment batteries, such as the Behavioural Inattention Test, combine structured tasks with functional components to provide a more detailed evaluation of neglect. However, these assessments are more time-consuming and may be less feasible in acute care settings.

Contemporary evidence highlights that reliance on a single assessment modality may underestimate the presence and severity of neglect. There is increasing recognition of the need for assessment approaches that capture neglect across multiple sensory modalities and functional contexts, particularly in patients with coexisting impairments such as aphasia (Williams et al., 2021). Accordingly, a combination of standardized tests and functional observations is recommended to ensure accurate identification and characterization of USN.

Behavioural Therapy-Based Interventions

Visual Scanning Training



Adopted from: https://www.teacherspayteachers.com/Product/Visual-Scanning-A-to-Z-3765433 and https://www.sciencedirect.com/topics/psychology/cancellation-test

Individuals with neglect are unable to visually scan their whole environment (Weinberg et al., 1977), particularly experiencing deficits on the side affected by their stroke (Ladavas et al., 1994). The literature concerning remediation of visuospatial deficits encompasses two basic approaches: (1) abilities and behaviours (visual scanning or visual perception), and (2) functional or constructional activities requiring spatial ability (Cicerone et al., 2000; Pierce & Buxbaum, 2002). The goal of these interventions is to improve visual functioning, allowing individuals to re-learn to scan and explore the affected hemifield.

Eleven RCTs evaluated visual scanning interventions for the rehabilitation of neglect. Three RCTs compared visual scanning to conventional rehabilitation in (Antonucci et al., 1995; Chan & Man, 2013; Ferreira et al., 2011). One RCT compared Dual to Single task visual scanning (van Kessel et al., 2013). Other studies assessed the effect of another intervention adjunct to visual scanning training, including one RCT on neck muscle vibration adds-on therapy (Schindler et al., 2002), one RCT on combination of saccade training and task-specific training (van Wyk et al., 2014), one RCT on limb activation added to visual scanning (Priftis et al., 2013), one RCT on rTMS adjunct therapy (Iwański et al., 2020), one RCT on tACS adjunct therapy (Middag-van Spanje et al., 2024), and two RCTs on TENS added to visual scanning (Rusconi et al., 2002; Seniów et al., 2016). Two RCTs compared smooth pursuit eye movement training and visual scanning training (Kerkhoff et al., 2014; Kerkhoff et al., 2013).

The methodological details and results of all 11 studies are presented in Table 1.

Table 1. RCTs evaluating visual scanning interventions for neglect rehabilitation.

Authors (Year) Study Design (PEDro) Sample Size$_{start}$ Sample Size$_{end}$ Time post stroke	Interventions Duration: Session length, frequency per week for total number of weeks	Outcome Measures Result (direction of effect)
Visual Scanning Training vs. Conventional Rehabilitation		
Chan & Man (2013) RCT (5) N_{Start}=40 N_{End}=40 TPS=Acute	E: Visual Scanning Training + Conventional Rehabilitation C: Conventional Rehabilitation Only Duration: 45min/d, 3d/wk, for 4wk visual scanning program & 2hr/d standard rehabilitation.	• Behavioural Inattention Test (-) • Visual Confrontation Test (-) • Catherine Bergego Scale (+exp)
Ferreira et al. (2011) RCT (5) N_{Start}=15 N_{End}=15 TPS=Chronic	E1: Visual Scanning Training + Physical Therapy (PT) E2: Mental Practice Training + PT C: Routine physiotherapy Duration: 1hr/d, 2d/wk, for 5wks	E1/E2 vs C • Behaviour Inattention Test (+exp1) • Functional Independence Measure ○ Total Score (-) ○ Self-Care: (+exp1)
Antonucci et al. (1995) RCT (3) N_{Start}=20 N_{End}=20 TPS=Subacute	E: Visual Scanning Training + Standard Rehabilitation C: Standard Cognitive Rehabilitation + Standard Rehabilitation Duration: Visual Scanning 1hr, 5x/wk, for 8wk, Cognitive Training 1hr/wk for 8wk	• Letter Cancellation Test (+exp) • Albert's Barrage Test (-) • Sentence Reading Test (+exp) • Wundt-Jastrow Area Illusion Test (+exp) • Semi-structured Scale for the Functional Evaluation of Hemi-Inattention - Extrapersonal Space (-)
Dual Task Visual Scanning vs. Single Task Visual Scanning		
Van Kessel et al. (2013) RCT (5) N_{Start}=29 N_{End}=29 TPS=Subacute	E: Dual Task Visual Scanning Training C: Single Task Visual Scanning Training Duration: 1hr/d, 5d/wk for 6wk	• Letter Cancellation Test (-) • Bells Test (-) • Line Bisection Test (-) • Reading Errors (-) • Gray Scales Index (-) • Baking Tray Index (-) • Comb and Razor (-) • Subjective Neglect Questionnaire (-) • Single and Dual Lane Tracking (-)
Visual Scanning + Neck Muscle Vibration vs. Visual Scanning alone		
Schindler et al. (2002) Cross-over RCT (4) N_{Start}=20 N_{End}=20 TPS=Subacute	E: Visual Exploration Training + Neck Muscle Vibration C: Visual Exploration Training Duration: 40min/d, 5d/wk for 3wk	• Visual Subjective Straight-ahead Judgements (+exp) • Cancellation Test (+exp) • Tactile Search (+exp) • Indented Text Reading (+exp) • Visual Size Discrimination (-)
Visual Scanning + Task Specific Training vs. Task Specific Training Alone		
Van Wyk et al. (2014) RCT (6) N_{Start}=24 N_{End}=24 TPS=Acute	E: Visual Scanning Exercises with Saccadic Eye Movement Training + Task-specific Activities C: Task-specific Activities alone Duration: 45min/d, 5d/wk, for 4wks	• King-Devick Test Subtest 1 (-) • King-Devick Test Subtest 2 (-) • King-Devick Test Subtest 3 (+exp) • Star Cancellation Test (+exp) • Barthel index (+exp)
Visual Scanning vs Limb Activation vs. Prism Adaptation		
Priftis et al. (2013) RCT (4) N_{Start}=33 N_{End}=31 TPS=Subacute	E1: Visual Scanning Training E2: Limb Activation Treatment E3: Prism Adaptation (10°) Duration: 20min, 2x/d 5d/wk for 2wk	• E1/E2 vs E3 • Fluff Test (-) • Comb and Razor Test (-) • Semi-structured Scale for the Functional Evaluation of Hemi-Inattention (-) • Room Description (-) • Picture Scanning (-) • Menu Reading (-) • Coin Sorting (-) • Catherine Bergego Scale (-)
Visual Scanning + Attention Training vs. Recreational Computer Activity		

Robertson et al. (1990) RCT (6) N_{Start}=36 N_{End}=33 TPS=Not Reported	E: Computer visual Scanning + Attentional Training C: Recreational Computer activity Duration: 45min/d, 3d/wk for 4wk	• Behavioural Inattention Test (-) • Rey-Osterreith Test (-) • Neale Reading Test (-) • Letter Cancellation Test (-) • Rey-Osterreith Test (-)
rTMS + Visual Scanning		
Iwanski et al. (2020) RCT (8) N_{Start}=28 N_{End}=27 TPS=Subacute	E: rTMS + Visual scanning training + Conventional therapy C: Sham rTMS + Visual scanning training + Conventional therapy Duration: 30min/d, 5d/wk for 3wks rTMS + 45min/d visual scanning training + 75min/d conventional rehabilitation	• Behavioral Inattention Test ○ Conventional (-) ○ Star Cancellation (-) ○ Letter Cancellation (-) ○ Behavioral subtest (-) • Visuospatial Scale (-) • Functional independence measure (-) • Functional assessment measure (-)
TENS + Visual Scanning		
Seniow et al. (2016) RCT (7) N_{Start}=29 N_{End}=29 TPS=Subacute	E: TENS + Visual scanning training C: Sham TENS + Visual scanning training Duration: 45min/d, 5d/wk, for 3wks	• Behavioural Inattention Test (-)
Rusconi et al. (2002) RCT (3) N_{Start}=20 N_{End}=20 TPS= Subacute	E1: Visual scanning training + verbal and visuo-spatial cues E2: Visual scanning training + verbal and visuo-spatial cues + TENS E3: Visual scanning training only (no feedback) + TENS E4: Visual scanning training only (no feedback) Duration: 1hr/d, 5d/wk for 8wks	E1/E2/E3/E4/C • Line Cancellation Test (-) • Letter Cancellation Test (-) • Line Bisection Test (-) • Sentence Reading (-) • Facial Recognition (-) • Position Sense (-) • Clock Test (-) • Drawing of 2 Houses (-) • Raven's Coloured Matrices (-)
tACS + Visual Scanning		
Middag-van Spanje et al. (2024) RCT (9) N_{Start}=22 N_{End}=19 TPS=Chronic	E: Transcranial alternating current stimulation (tACS) + Visual Scanning Training (VST) C: Sham tACS + VST Duration: 40min, 3x/wk for 6wk	• Star Cancellation Task (+exp) • Computerized Visual Detection Task (+exp) • McIntosh Line Bisection Task - digitized (MLBT-d) (-) • Schenkenberg Line Bisection Task (-) • Baking Tray Task (-) • Catherine Bergego Scale (-) • Subjective Neglect Questionnaire (-)
Smooth Pursuit Eye Movement Training + Visual Scanning		
Kerkhoff et al. (2014) RCT (7) N_{Start}=24 N_{End}=24 TPS= Subacute	E: Smooth Pursuit Eye Movement Training C: Visual Scanning Training Duration: 30min/d, 5d/wk, 4wks	• Functional Neglect Index (+exp) • Unawareness and Behavioural Neglect Scale (+exp) • Barthel Index (-)
Kerkhoff et al. (2013) RCT (6) N_{Start}=50 N_{End}=45 TPS=Subacute	E: Smooth Pursuit Eye Movement Training + Standard rehabilitation C: Visual Scanning Training + Standard rehabilitation Duration:50min/d, 5 sessions over 7-9 days	• Auditory Subjective Midline Test (+exp) • Paragraph Reading Task (+exp) • Line Bisection (-) • Single Digit Cancellation (+exp) • Double Digit Cancellation (+exp)

Abbreviations and table notes: C=control group; D=days; E=experimental group; H=hours; Min=minutes; RCT=randomized controlled trial; TPS=time post stroke category (Acute: less than 30 days, Subacute: more than 1 month but less than 6 months, Chronic: over 6 months); Wk=weeks.
+exp indicates a statistically significant between groups difference at α=0.05 in favour of the experimental group
+exp_2 indicates a statistically significant between groups difference at α=0.05 in favour of the second experimental group
+con indicates a statistically significant between groups difference at α=0.05 in favour of the control group
- indicates no statistically significant between groups differences at α=0.05

Conclusions about visual scanning training

VISUOSPATIAL PROCESSING & USN			
LoE	**Conclusion Statement**	**RCTs**	**References**
2	There is mixed evidence about the use of **visual scanning** for improving neglect when compared to **conventional rehabilitation**.	3	Chan & Man, 2013; Ferreira et al., 2011; Antonucci et al., 1995
1b	There is conflicting evidence about the use of **visual scanning** added to **task specific training** for improving neglect when compared to **task specific training** alone.	1	Van Wyk et al., 2014
2	**Dual-task visual scanning** may not have a difference in efficacy compared to **Single-task visual scanning** for improving neglect.	1	Van Kessel et al., 2013
2	**Visual scanning** may not have a difference in efficacy compared to **limb activation** or **prism adaptation** for improving neglect.	1	Prifitis et al., 2013
1b	**rTMS** added to **visual scanning** may not have a difference in efficacy compared to **visual scanning** alone for improving neglect.	1	Iwanski et al., 2020
1b	**TENS** added to **visual scanning** may not have a difference in efficacy compared to **visual scanning** alone for improving neglect.	2	Seniow et al., 2016; Rusconi et al., 2002
1b	**tACS** added to **visual scanning** may not have a difference in efficacy compared to **visual scanning** alone for improving neglect.	1	Middag-van Spanje et al., 2024
2	**Neck Muscle Vibration** added to **Visual scanning** may produce greater improvements in neglect than **Visual scanning** alone.	1	Schindler et al., 2002
1a	**Smooth pursuit eye movement training** may produce greater improvements in neglect than **visual scanning training.**	2	Kerkhoff et al., 2013; Kerkhoff et al., 2014

NEGLECT- SPECIFIC ADLs			
LoE	**Conclusion Statement**	**RCTs**	**References**
2	**Dual-task visual scanning** may not have a difference in efficacy compared to **Single-task visual scanning** for improving neglect-specific ADL.	1	Van Kessel et al., 2013
2	There is mixed evidence about the use of **visual scanning** for improving neglect-specific ADL when compared to **conventional rehabilitation**.	2	Chan & Man, 2013; Antonucci et al., 1995
2	**Visual scanning** may not have a difference in efficacy compared to **limb activation** or **prism adaptation** for improving neglect-specific ADL.	1	Prifitis et al., 2013
1b	**Smooth pursuit eye movement training** may produce greater improvements in neglect than **visual scanning training.**	1	Kerkhoff et al., 2014

GENERAL ADLs			
LoE	**Conclusion Statement**	**RCTs**	**References**
2	**Visual scanning** may not have a difference in efficacy compared to **conventional rehabilitation** for improving general ADL.	1	Ferreira et al., 2011;
2	**Neck Muscle Vibration** added to **Visual scanning** may produce greater improvements in general ADL than **Visual scanning** alone.	1	Schindler et al., 2002
1b	**Visual scanning training** added to **task specific training** may produce greater improvements in general ADL than **task specific training** alone.	1	Van Wyk et al., 2014
1b	**rTMS** added to **visual scanning** may not have a difference in efficacy compared to **visual scanning** alone for improving general ADL.	1	Iwanski et al., 2020

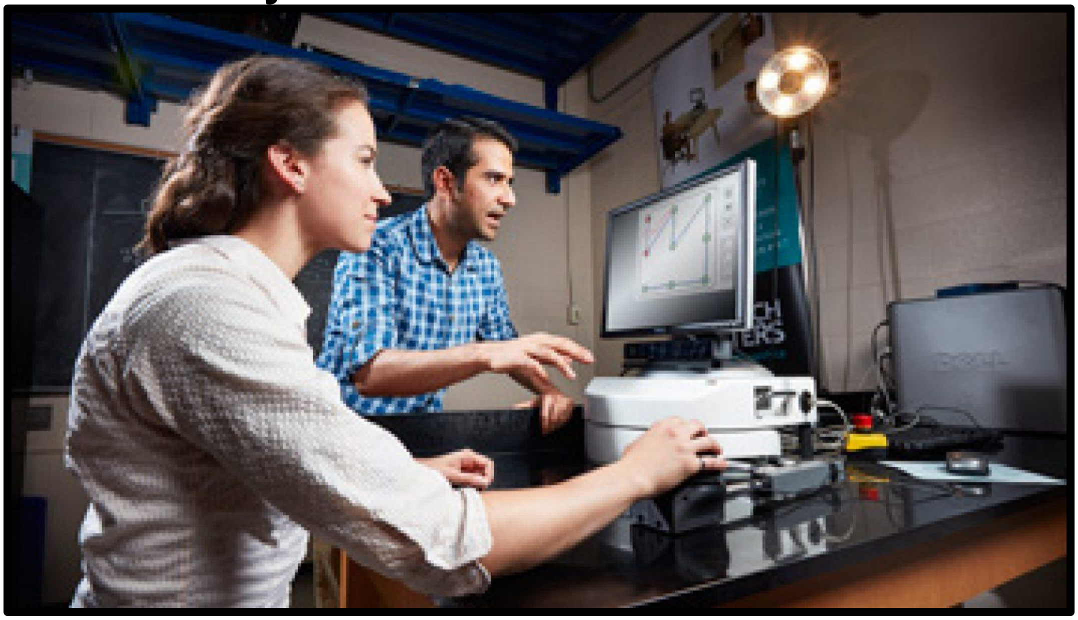
Key Points

The literature is mixed regarding visual scanning training for improving USN or neglect-specific ADLs compared to conventional therapies.

Non-invasive brain stimulations and TENS added to visual scanning training may not have a difference in efficacy compared to visual scanning alone for improving USN.

Smooth pursuit eye movement training may be beneficial in improving USN and neglect-specific ADLs compared to visual scanning training.

Virtual Reality-Based Rehabilitation



Adopted from: https://engineerthefuture.ca/rehab-robot-improves-care-for-stroke-patients/

Traditionally, post-stroke neglect rehabilitation has been constrained to real-world therapies. More recently, virtual reality-based approaches are becoming more viable as technology becomes more realistic, user-friendly and affordable. A 2015 systematic review from Pedroli and colleagues outlined three 'critical challenges' that need to be addressed when designing virtual-reality interventions. They are: (1) using an ergonomic design that enables those in wheelchairs or with hemiparesis; (2) software that is user friendly for clinical staff and patients; and (3) costs that are affordable for all patients (Pedroli et al., 2015).

Seven RCTs were found evaluating computer-based interventions for neglect rehabilitation. Five of these RCTs compared virtual reality training to conventional training (Choi et al., 2021; Kim et al., 2011; Motomura et al., 2024; Shin et al., 2023; Stammler et al., 2023). Two RCTs compared virtual reality attention training to visual scanning (Katz et al., 2005; Osaki et al., 2024).

The methodological details and results of all 7 RCTs are presented in Table 2.

Table 2. RCTs evaluating virtual reality-based rehabilitation interventions for neglect rehabilitation.

Authors (Year) Study Design (PEDro) Sample Size$_{start}$ Sample Size$_{end}$ Time post stroke	Interventions Duration: Session length, frequency per week for total number of weeks	Outcome Measures Result (direction of effect)
Virtual Reality Training vs. Conventional Rehabilitation		
Shin et al. (2023) RCT (7) N_{Start}=11 N_{End}=11 TPS=Chronic	E: Virtual Reality-Visual Exploration Therapy + Conventional rehabilitation for stroke and neglect C: Waitlist + Conventional rehabilitation for stroke and neglect Duration: 5d/wk, for 4wks VR	• Line Bisection Test (+exp) • Star Cancellation Test (-) • Catherine Bergego Scale (-) • Field of Perception ○ response time (-) ○ left response time (+exp) ○ right response time (-) ○ success rate (-) ○ success rate left (+exp) ○ success rate right (-)

		• Field of Regard: ○ reaction time (+exp) ○ left reaction time (+exp) ○ right reaction time (-) ○ success rate (+exp) ○ left success rate (+exp) ○ right success rate (-) ○ head movement (-) ○ head movement left (-) ○ head movement right (-)
Stammler et al. (2023) RCT (4) N_{Start}=20 N_{End}=20 TPS=Subacute	E: Augmented reality-based app Negami C: Standard neglect therapy Duration: 25min/d, 5d/wk for 2wks	• Letter Cancellation (-) • Bells Test (+exp) • Copying Task (+exp) • Line Bisection Task (-) • Exploration Test (+exp)
Choi et al. (2021) RCT (8) N_{Start}=24 N_{End}=24 TPS=Subacute	E: Virtual Reality-Based Digital Practice C: Conventional USN Specific Training Duration: Digital Practice 30min/d, 3d/wk, 4wks Conventional Training 1-hr therapy session, 5 d/wk, 4wks	• Line Bisection Test (+exp) • Modified Barthel Index (-) • Catherine Bergego Scale (-) • Motor-Free Visual Perception Test (+exp) • Horizontal head movement of rotation ○ Response Behavior Left (+exp) ○ Response Behaviour Right (-) ○ Performance Behavior Left (+exp) ○ Performance Behavior Right (+exp) ○ Processing Time (+exp)
Kim et al. (2011) RCT (3) N_{Start}=24 N_{End}=21 TPS=Acute	E: Virtual Reality Training C: Conventional Rehabilitation Duration: 30min/d, 5d/wk for 3wks	• Star Cancellation Test (+exp) • Line Bisection Test (-) • Catherine Bergego Scale (+exp) • Barthel index
Virtual Reality Attention Training vs. Visual Scanning		
Osaki et al. (2024) RCT (9) N_{Start}=28 N_{End}=28 TPS=Subacute	E: VR balloon search attention training C: Visual scanning training + Conventional rehabilitation Duration: 10min/d, 5d/wk, for 2wk	• Behavioural Inattention Test (+exp) • Catherine Bergego Scale (+exp) • Modified Posner Task ○ reaction time (+exp) ○ accuracy (-)
Katz et al. (2005) RCT (5) N_{Start}=19 N_{End}=19 TPS=Subacute	E: Virtual Reality Street Crossing Attention Training C: Standard Computer-Based Visual Scanning Duration: 45 min/session, 3sessions/wk, 4wks	• Star Cancellation (-) • Mesulam Cancellation (-) • Virtual Reality Street Crossing Accidents (+exp) • Real Street Crossing Results: ○ Mean Number of Times Participants Looked to the Left Before Crossing (-) ○ Decision Time to Cross the Street per Vehicle (-)
Virtual Reality Attention Training vs. Object Gaze Task		
Motomura et al. (2024) RCT (8) N_{Start}=42 N_{End}=40 TPS=Acute	E1: Stimulus response task using VR + Background shift E2: Stimulus response task using VR C: Object gazing task Duration: 2x/d, for 5d	E1/E2 v C • Stimulus-driven Attention Test: ○ Left -3 (+exp1, +exp2) ○ Left -2 (+exp1) ○ Left -1 (-) ○ Right +1 (-) ○ Right +2 (+exp1, +exp2) ○ Right +3 (+exp1, +exp2) • Behavioral Inattention Test conventional (-) • Catherine Bergego Scale (-) • Straight ahead pointing tests (-)

		E1 v E2 • Stimulus-driven Attention Test: ○ Left -3 (-) ○ Left -2 (+exp1) ○ Left -1 (-) ○ Right +1 (-) ○ Right +2 (-) ○ Right +3 (-) • Behavioral Inattention Test conventional (-) • Catherine Bergego Scale (-) • Straight ahead pointing tests (-)

Abbreviations and table notes: C=control group; D=days; E=experimental group; H=hours; Min=minutes; RCT=randomized controlled trial; TPS=time post stroke category (Acute: less than 30 days, Subacute: more than 1 month but less than 6 months, Chronic: over 6 months); Wk=weeks.
+exp indicates a statistically significant between groups difference at α=0.05 in favour of the experimental group
+exp_2 indicates a statistically significant between groups difference at α=0.05 in favour of the second experimental group
+con indicates a statistically significant between groups difference at α=0.05 in favour of the control group
- indicates no statistically significant between groups differences at α=0.05

Conclusions about virtual reality-based rehabilitation

VISUOSPATIAL PROCESSING & USN			
LoE	**Conclusion Statement**	**RCTs**	**References**
1a	There is mixed evidence about the use of **virtual reality-based training** for improving neglect when compared to **conventional rehabilitation.**	4	Shin et al., 2023; Stammler et al., 2023; Choi et al., 2021; Kim et al., 2011
1b	**Virtual reality attention training** may not have a difference in efficacy compared to **computer-based visual scanning** for improving neglect.	1	Osaki et al., 2023; Katz et al., 2005
1b	**Virtual reality stimulus response task** may not have a difference in efficacy compared to **object gaze task** for improving neglect.	1	Motomura et al., 2024

NEGLECT- SPECIFIC ADLs			
LoE	**Conclusion Statement**	**RCTs**	**References**
1a	**Virtual reality-based training** may not have a difference in efficacy compared to **conventional rehabilitation** for improving neglect-specific ADL.	3	Shin et al., 2023; Choi et al., 2021; Kim et al., 2011
1b	**Virtual reality attention training** may produce greater improvements in neglect-specific ADL than **Visual scanning training.**	2	Osaki et al., 2023; Katz et al., 2005
1b	**Virtual reality stimulus response task** may not have a difference in efficacy compared to **object gaze task** for improving neglect- specific ADL.	1	Motomura et al., 2024

GENERAL ADLs			
LoE	**Conclusion Statement**	**RCTs**	**References**
1b	**Virtual reality-based training** may not have a difference in efficacy compared to **conventional rehabilitation** for improving general ADL.	2	Choi et al., 2021; Kim et al., 2011
2	**Virtual reality attention training** may produce greater improvements in general ADL than **Visual scanning training.**	1	Katz et al., 2005

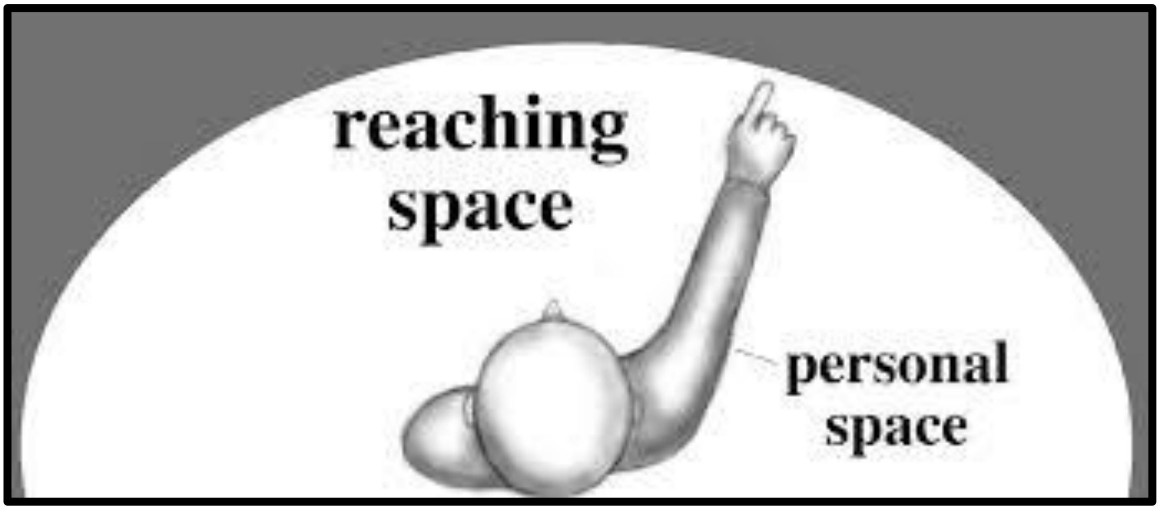
Key Point

The literature is mixed regarding virtual reality-based training for improving USN compared to conventional rehabilitation.

Virtual reality-based training may not be beneficial for improving neglect-specific or general ADLs compared to conventional rehabilitation.

Virtual reality attention training may not be beneficial for improving USN outcomes but effective for improving neglect-specific or general ADLs compared to visual scanning training and object gaze task.

Limb Activation



Adopted from: https://www.tandfonline.com/doi/abs/10.1080/09602010244000228?journalCode=pnrh20

Limb activation therapy for neglect is based on activating spatial and motor representations of specific areas which are not being attended to. By increasing this activation, an individual can increase the representation of that spatial sector. In one of the first studies examining this intervention for neglect treatment, Robertson and North (1992) showed that only when the contralateral limb was activated in the contralesional space, patients saw an improvement in neglect. In addition, they also showed that this improvement was independent of the visual cue provided by seeing the limb and could be elicited from movement alone (Robertson & North, 1992). Traditionally, there have been mixed results concerning whether passive movement can ameliorate neglect as well (Frassinetti et al., 2001; Robertson & North, 1993). Considering the high prevalence of motor impairment post-stroke, passive movement could prove an effective and accessible treatment for many.

Eight RCTs were found evaluating limb activation interventions for neglect rehabilitation. Two RCTs compared cued limb activation to conventional rehabilitation (Fong et al., 2013; Kalra et al., 1997). One RCT compared constraint induced therapy with eye patching to conventional rehabilitation and constraint induced therapy alone (Wu et al., 2013). One RCT compared limb activation to attentional training (Reinhart et al., 2012). One RCT compared limb activation with perceptual training to perceptual training alone (Robertson et al., 2002). One RCT compared limb activation to visual scanning training, and prism adaptation (Priftis et al., 2013). One RCT compared limb activation to visual scanning training (Luukkainen-Markkula et al., 2009). One RCT compared hand intrinsic muscle movement to common upper extremity tasks (Ma & Yang, 2019).

The methodological details and results of all 8 RCTs are presented in Table 3.

Table 3. RCTs evaluating limb activation interventions for neglect rehabilitation.

Authors (Year) Study Design (PEDro) Sample Size$_{start}$ Sample Size$_{end}$ Time post stroke	Interventions Duration: Session length, frequency per week for total number of weeks	Outcome Measures Result (direction of effect)
Cued Limb Activation vs. sham/ Conventional Rehabilitation		

Fong et al. (2013) RCT (8) N_{Start}=40 N_{End}=35 TPS=Acute	E: Sensory-Cued Active Arm Movements + Conventional Rehabilitation C: Sham sensory cuing with instructions to move the limb as much as possible + Conventional Rehabilitation Duration: 3hr/d, 5d/wk, for 3wk	• Behavioural Inattention Test ○ Cancellation Tasks (-) ○ Drawing Tasks (+exp) • Functional Independence Measure (-)
Kalra et al. (1997) RCT (6) N_{Start}=50 N_{End}=47 TPS=Acute	E: Spatiomotor Cueing (the movement of the affected limb was directed toward the deficit hemispace) C: Conventional Therapy Duration: 12wk	• Rivermead Perceptual Assessment Battery ○ Cancellation (+exp) ○ Body Image (+exp) ○ Picture Matching (-) ○ Object Matching (-) ○ Size Recognition (-) ○ Series (-) ○ Missing Article (-) ○ Sequencing-pictures (-) ○ Right/Left Copying (-) ○ Word Colour Matching (-) ○ 3-dimensional Copying (-) ○ Figure Ground Discrimination (-) ○ Animal Halves (-)
Constraint Induced Therapy + Eye Patching vs. Conventional Rehabilitation		
Wu et al. (2013) RCT (7) N_{Start}=27 N_{End}=24 TPS=Chronic	E1: Constraint Induced Therapy + Eye Patching E2: Constraint Induced Therapy C: Conventional Rehabilitation Duration: 2hr/d, 5d/wk for 3wk & 6hr/d Constraint-induced movement	E1/E2 vs C • Catherine Bergego Scale (+exp1; +exp2) • Eye Movement: ○ Left Fixation Points (+exp2; +con), ○ Amplitude (-) ○ Left Fixation Time (-) E1 vs E2 • Catherine Bergego Scale (-) • Eye Movement (-): ○ Left Fixation Points (+exp2) ○ Amplitude (-) ○ Left Fixation Time (-)
Limb Activation vs. Attentional Training		
Reinhart et. al. (2012) RCT Cross-over (5) N_{start}=8 N_{end}=8 TPS=Subacute	E1: Passive Left Limb Activation E2: Alertness Cueing Duration: 60min/d, 2d	• Hand Judgement Task (+exp) • Paragraph Reading Test (-) • Line-bisection deviation (-) • Number Cancellation (-)
Limb Activation + Perceptual Training vs. Perceptual Training		
Robertson et al. (2002) RCT (6) N_{Start}=40 N_{End}=36 TPS=Subacute	E: Limb Activation Treatment + Standard Perceptual Training C: Standard Perceptual Training Duration: 45min/d, 1d/wk for 12wk	• Behavioural inattention test (-) • Landmark test- adapted version (-) • Catherine Bergego Scale (-) • Comb and Razor Test (-) • Barthel Index (-)
Limb Activation vs Visual Scanning vs. Prism Adaptation		
Priftis et al. (2013) RCT (4) N_{Start}=33 N_{End}=31 TPS=Subacute	E1: Visual Scanning Training E2: Limb Activation Treatment E3: Prism Adaptation (10°) Duration: 20min, 2x/d 5d/wk for 2wk	E1/E2 vs E3 • Comb and Razor Test (-) • Fluff Test (-) • Picture Scanning (-) • Menu Reading (-) • Coin Sorting (-) • Semi-structured Scale for the Functional Evaluation of Hemi-Inattention (-) • Room Description (-) • Catherine Bergego Scale (-)

Luukkainen-Markkula et al. (2009) RCT (5) N_{Start}=12 N_{End}=12 TPS=Subacute	E: Left Arm Activation C: Visual Scanning Training Duration: 60min/d,4d/wk	• Catherine Bergego Scale (-) • Behavioural Inattention Test (-) • Rey Osterrieth (-)
Task Application Hand Intrinsic Muscle Movement vs. Common Upper Extremity Task		
Ma et al. (2019) RCT (5) N_{Start}=20 N_{End}=20 TPS=Chronic	E: Task Application After Hand Intrinsic Muscle Treatment C: Common Upper Extremity Task Duration: 30min/d, 5d/wk, 2wks	• Albert's Test (+exp) • Line Bisection Test (+exp)

Abbreviations and table notes: C=control group; D=days; E=experimental group; H=hours; Min=minutes; RCT=randomized controlled trial; TPS=time post stroke category (Acute: less than 30 days, Subacute: more than 1 month but less than 6 months, Chronic: over 6 months); Wk=weeks.
+exp indicates a statistically significant between groups difference at α=0.05 in favour of the experimental group
+exp_2 indicates a statistically significant between groups difference at α=0.05 in favour of the second experimental group
+con indicates a statistically significant between groups difference at α=0.05 in favour of the control group
- indicates no statistically significant between groups differences at α=0.05

Conclusions about limb activation

VISUOSPATIAL PROCESSING & USN			
LoE	**Conclusion Statement**	**RCTs**	**References**
1a	**Cued Limb activation** may not have a difference in efficacy compared to **conventional rehabilitation** for improving neglect.	2	Fong et al., 2013; Kalra et al., 1997
1b	**Constraint induced therapy either with or without eye patching** may not have a difference in efficacy compared to **conventional rehabilitation or constraint induced therapy alone** for improving neglect.	1	Wu et al., 2013
1b	**Limb activation added to perceptual training** may not have a difference in efficacy compared to **perceptual training alone** for improving neglect.	1	Robertson et al., 2002
2	**Limb activation** may not have a difference in efficacy compared to **attentional training** for improving neglect.	1	Reinhart et al., 2012
2	**Limb activation** may not have a difference in efficacy compared to **prism adaptation** for improving neglect.	1	Priftis et al., 2013
2	**Limb activation** may not have a difference in efficacy compared to **visual scanning training** for improving neglect.	1	Luukkainen-Markkula et al., 2009
2	**Task application after hand intrinsic muscle treatment** may produce greater improvements in neglect than **common upper extremity tasks.**	1	Ma et al., 2019

NEGLECT- SPECIFIC ADLs			
LoE	**Conclusion Statement**	**RCTs**	**References**
1b	**Constraint induced therapy with eye patching** may produce greater improvements in neglect-specific ADLs than **conventional rehabilitation.**	1	Wu et al., 2013

1b	**Constraint induced therapy** may produce greater improvements in neglect specific ADLs than **conventional rehabilitation.**	1	Wu et al., 2013
1b	**Constraint induced therapy with eye patching** may not have a difference in efficacy compared to **constraint induced therapy alone** for improving neglect-specific ADLs.	1	Wu et al., 2013
1b	**Limb activation added to perceptual training** may not have a difference in efficacy compared to **perceptual training alone** for improving neglect-specific ADLs.	1	Robertson et al., 2002
2	**Limb activation** may not have a difference in efficacy compared to **prism adaptation** for improving neglect-specific ADLs.	1	Priftis et al., 2013
2	**Limb activation** may not have a difference in efficacy compared to **visual scanning training** for improving neglect-specific ADLs.	1	Luukkainen-Markkula et al., 2013

GENERAL ADLs			
LoE	**Conclusion Statement**	**RCTs**	**References**
1b	**Cued Limb activation** may not have a difference in efficacy compared to **conventional rehabilitation** for improving general ADLs.	1	Fong et al., 2013
1b	**Limb activation added to perceptual training** may not have a difference in efficacy compared to **perceptual training alone** for improving general ADLs.	1	Robertson et al., 2002

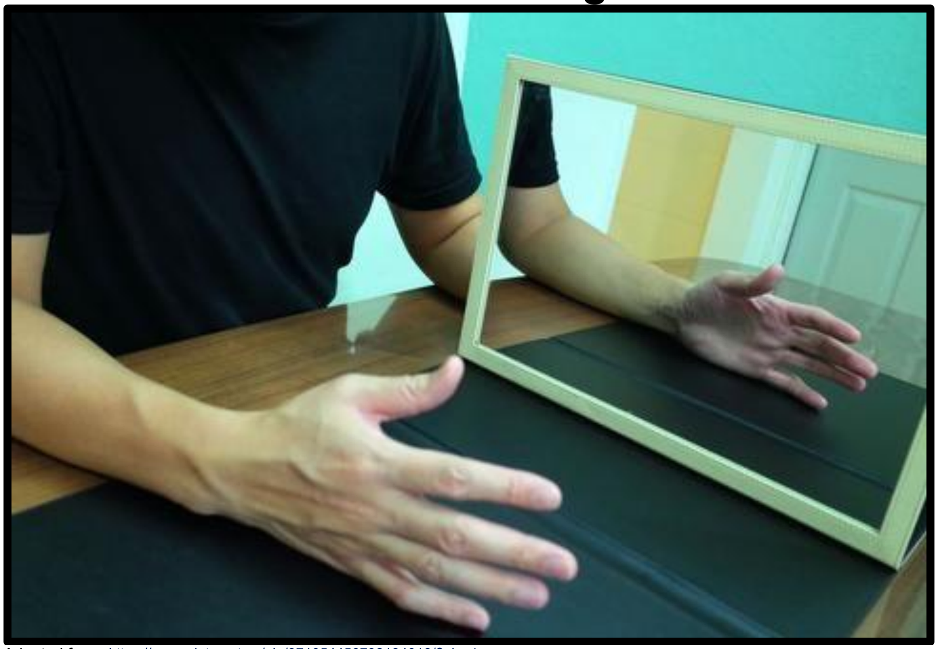
Key Points

Cued limb activation may not be beneficial for improving USN and general ADLs when compared to conventional rehabilitation.

Constraint induced therapy either with or without eye patching may not have a difference in efficacy compared to conventional rehabilitation or constraint induced therapy alone for improving USN or neglect-specific ADLs.

Limb activation added to perceptual training may not have a difference in efficacy compared to perceptual training alone for improving USN, neglect-specific ADLs, and general ADLs.

Visuomotor Feedback Strategies



Adapted from: https://www.pinterest.ca/pin/371054456792134018/?nic=1a

A common feature of neglect is that those who suffer from it are usually unaware of the deficit, having no conscious recognition of any problems as they occur (Bisiach et al., 1986). Although popular, some interventions like visual scanning receive criticism because they rely on the self-awareness and intention of the participant. Therefore, therapies that provide direct feedback (externally or internally) can aid in the acknowledgement of when a perceptual error is occurring and allow the individual to properly correct it. These types of strategies allow for 'trial-and-error' learning, whereas before the error itself could not be apparent. By establishing this feedback loop the necessary conditions for operant conditioning can be maintained and training can have the potential to be more effective. The feedback can be in different modalities, such as visual, verbal cueing, auditory, sensory stimulation, perceptual, tactile, or any other feedback that help the participants have a better task performance.

Eighteen RCTs were found that evaluated feedback-based strategy trainings for neglect rehabilitation. Three RCTs examined mirror therapy: Two compared mirror training and sham training (Fong et al., 2022; Pandian et al., 2014) and one compared bimanual versus unimanual mirror therapy (Sim & Kwon, 2022). Three RCTs examined cueing training with contra-lesional sensory stimulation (Geiser et al., 2024; Karner et al., 2019; Sukumaran et al., 2020). Three RCTs examined cuing and strategy-based visual scanning training (Roy et al., 2024; Toglia & Cermak, 2009; Turgut et al., 2018). Two RCTs examined robot-assisted training with sensory feedback (Chen et al., 2021; Park, 2021). Two RCTs examined visuomotor imagery therapy (Park & Lee, 2015; Welfringer et al., 2011). One RCT examined kinesthetic ability training (Kutlay et al., 2018), one RCT examined body awareness training (Bang et al., 2015), one RCT examined eye tracking glasses with biofeedback (Fanthome et al., 1995), one RCT examined a visual perception motion tracking programme (Si Hyun et al., 2009), and one RCT examined visuomotor feedback training (rod balancing training) (Rossit et al., 2019).

The methodological details and results of all 18 RCTs are presented in Table 4.

Table 4. RCTs evaluating feedback-based training interventions for neglect rehabilitation.

Authors (Year) Study Design (PEDro) Sample Size$_{start}$ Sample Size$_{end}$ Time post stroke	Interventions Duration: Session length, frequency per week for total number of weeks	Outcome Measures Result (direction of effect)
Mirror training		
Fong et al. (2022) RCT (7) N_{Start}=21 N_{End}=15 TPS=Subacute	E1: Mirror visual feedback, E2: Sham 1 using transparent glass C: Sham 2 using covered mirror Duration: 30min/d, 4d/wk for 3wks	E1/E2 v C • Behavioural Inattention test-conventional (-) • Line Crossing (+exp1) • Letter Cancellation (-) • Star Cancellation (-) • Figure and Shape Copying (-) • Line Bisection (-) • Representative Drawing (-) • Catherine Bergego (-) • Gap Detection Test ○ total crossed circle left space (-) ○ total crossed circle right space (-) ○ total crossed left-gap circle left space (+exp1) ○ total crossed left-gap circle right space (-) ○ total crossed right-gap circle left space (-) ○ total crossed right-gap circle right space (-) ○ total crossed triangle left space (-) ○ total crossed triangle right space (-) ○ total crossed left-gap triangle left space (-) ○ total crossed left-gap triangle right space (+exp1) ○ total crossed right-gap triangle left space (-) ○ total right-gap triangle right space (-)
Sim et al. (2014) RCT (5) N_{Start}=30 N_{End}=28 TPS=Chronic	E: Bimanual mirror therapy C: Unimanual mirror therapy Duration: 30min/d,5d/wk,4wks	• The Star cancellation Test (+exp) • Line Bisection Test (+exp) • Picture Scanning Test (+exp) Korean Catherine Bergego Scale (+exp)
Pandian et al. (2014) RCT (8) N_{Start}=48 N_{End}=46 TPS=Acute	E: Mirror Training + Limb Activation C: Sham Mirror Training + Limb Activation Duration: 1-2hr/d, 5d/wk, for 4wk	• Star Cancellation Test (+exp) • Line Bisection Test (+exp) Picture Identification Task (+exp)
Contralesional sensory stimulation		
Geiser et al. (2024) RCT (6) N_{Start}=28 N_{End}=28 TPS=Acute	E1: Auditory Motion Stimulation E2: Visual Motion Stimulation E3: Multimodal Motion Stimulation C: No Treatment Duration: 15min	E1/E2/E3 v C: • Mean Gaze Position (+exp1)
Sukumaran et al. (2020) RCT (6) N_{Start}=14 N_{End}=12 TPS=Acute	E: Visual and Auditory stimulation with cued motor tasking + Standard physiotherapy and gait training C: Standard Post-Stroke Physiotherapy and Gait Training Duration: 20-30min/session, 2sessions/d, 1mo	• Star Cancellation Test (+exp) • Line Bisection Test (-) • Picture Identification Task (-) • National Institutes of Health Stroke Scale (-) • Modified Rankin Scale Score (-)

Karner et al. (2019) RCT (6) N_{Start}=47 N_{End}=39 TPS=Subacute	E: Cueing Training with the Personal Interactive Robot (PARO) C: Reading aloud for patients Duration: 30min, 3d/wk, 2wks	• Cats Test (+exp) • Line Bisection Test (-) • Scores of Independence Index for Neurological and Geriatric Rehabilitation (SINGER) - Self-Care (-) • SINGER - Mobility (-) • SINGER - Communication (-) • SINGER - Cognitive Abilities (+exp)
Cuing and strategy-based visual scanning training		
Roy et al. (2024) RCT (8) N_{Start}=32 N_{End}=32 TPS=Acute	E: Education on cueing (including environmental modification, visual scanning, eye patching, visual/verbal/tactile cueing) C: Conventional care Duration: 15min/d + 40min standard care, for 5d	• Line Bisection Test (+exp) • Catherine Bergego Scale (+exp)
Turgut et al. (2018) RCT (7) N_{Start}=26 N_{End}=17 TPS=Subacute	E: Reading Task with Adaptive Cueing C: General Neuropsychological treatment Duration: 5d/wk, 3wks	• Text Reading (+exp) • Word Reading (+exp) • Catherine Bergego Scale (+exp) • Clock Drawing Test (+exp) • Line Bisection (+exp) Apples Cancellation Task (+exp)
Toglia et al. (2009) RCT (7) N_{Start}=40 N_{End}=40 TPS=Subacute	E: Object Search Task with dynamic cueing Toglia (strategy training and feedback if needed) C: Object Search Task Duration: 30min	• Object Search Task (+exp) • Object Detection Score (+exp) • Laterality Index (+exp)
Robot-Assisted training with sensory feedback		
Chen et al. (2021) RCT (7) N_{Start}=20 N_{End}=20 TPS=Subacute	E: Robot-Assisted Arm Training (robotic exoskeleton with motion sensors, with audiovisual feedback and cues) C: Conventional Therapy (general cognitive and occupational rehabilitation dedicated for USN) Duration: 45min/d, 5d/wk, 4wks	• Behavioral Inattention Test (+exp) • Catherine Bergego Scale (-) • Modified Barthel Index (-) • World Health Organization Disability Assessment Schedule Version 2.0 - Social Participation (+exp)
Park et al. (2021) RCT (7) N_{Start}=24 N_{End}=24 TPS=Chronic	E: Robot-Assisted Left-Hand Training (adaptive assistance+ real-time visual feedback) C: Conventional Treatments for Neglect Symptoms Duration: 30min/d, 5d/wk, 4wks	• Line Bisection Test (+exp) • Albert's Test (+exp) Catherine Bergego Scale (+exp)
Visuomotor Imagery Therapy		
Park & Lee (2015) RCT (9) N_{Start}=30 N_{End}=30 TPS=Chronic	E: Mental practice + standard rehabilitation C: Standard rehabilitation Duration: 10min/d,5d/wk,4wks	• Star cancellation test (-) • Line bisection test (+exp)
Welfringer et al. (2011) RCT (7) N_{Start}=30 N_{End}=30 TPS=Subacute	E: Visuomotor Imagery Therapy C: Standard Care Duration: 30 min/session, 2 sessions/d, 5d/wk, 3wks	• Bells Cancellation (-) • Reading (-) • Flower Copying (-) • Clock Drawing (-) • Body Touching (-) • Visual Arm Imagery (-) • Sensation (-)
Balance Feedback Training		
Kutlay et al. (2018) RCT (7) N_{Start}=64	E: Kinesthetic Ability Training (KAT) + Standard Neglect Rehabilitation C: Standard Neglect Rehabilitation	• Behavioural Inattention Test (-) ○ Line Crossing (-) ○ Letter Cancellation (-)

N_{End}=53 TPS=Subacute	Duration: 20-30min/d, 5d/wk for 4wks Training; 2-3h/d, 5d/wk for 4wks standard neglect rehabilitation	○ Star Cancellation (-) ○ Figure and Shape Copying (-) ○ Line Bisection (-) ○ Representational Drawing (-) ○ Picture Scanning (-) ○ Telephone Dialing (-) ○ Menu reading (-) ○ Article Reading (-) ○ Telling & Setting Time (-) ○ Coin Sorting (-) ○ Address & Sentence Copying (-) ○ Map Navigation (-) ○ Card Sorting (-) • Functional Independence Measure (-)
Bang et al. (2015) RCT (7) N_{Start}=12 N_{End}=12 TPS=Acute	E: Body awareness training + task-oriented training C: task-oriented training Duration: 30-45min/d,5d/wk,3wks	• Motor-Free Visual Perception Test (+exp) • Line bisection test (+exp)
Eye movement biofeedback training		
Fanthome et al. (1995) RCT (6) N_{Start}=18 N_{End}=18 TPS=Subacute	E: Eye-tracking Feedback Training Glasses (with real-time auditory signal feedback) C: No Treatment Duration 40min/d, 4d over 4wk	• Behaviour Inattention Test: ○ Conventional Subtest (-) ○ Behavioural Subtest (-) • Eye Movement (-)
Rod lifting training		
Rossit et al. (2019) RCT (6) N_{Start}=20 N_{End}=18 TPS=Subacute	E: Home-based Visuomotor Feedback Training (Rod balancing training) C: Home-based simple road lifting task (non-neglected side) Duration: Two 30-min experimenter-led sessions+ 30 min/session, 5 sessions/wk, 2wks self-administrated training at home.	• Line Bisection (+exp) • Behavioural Inattention Test: ○ Post-intervention scores (-) ○ Total gain score (+exp) • Balloons Test (-) • Landmark Task (-) • Subjective Straight-Ahead Description Task (-) • Room Description Task (-) • Stroke Impact Scale: ○ ADL/IADL (+exp) ○ Hand Function (-) ○ Stroke Recovery (-)
Computerized visual perception rehabilitation		
Si Hyun Kang et al. (2009) RCT (7) N_{Start}=16 N_{End}=16 TPS=Subacute	E: Interactive Computerized Visual Perception Rehabilitation Programme using CAMSHIFT Motion Tracking Technology C: PSS CogRehab Program Duration: 30 min/d, 3d/wk, 4wks	• Mini-Mental Status Examination (-) • Motor-Free Visual Perception Test (-) • Korean Modified Barthel Index (-)

Abbreviations and table notes: C=control group; D=days; E=experimental group; H=hours; Min=minutes; RCT=randomized controlled trial; TPS=time post stroke category (Acute: less than 30 days, Subacute: more than 1 month but less than 6 months, Chronic: over 6 months); Wk=weeks.
+exp indicates a statistically significant between groups difference at α=0.05 in favour of the experimental group
+exp_2 indicates a statistically significant between groups difference at α=0.05 in favour of the second experimental group
+con indicates a statistically significant between groups difference at α=0.05 in favour of the control group
- indicates no statistically significant between groups differences at α=0.05

Conclusions about visuomotor feedback strategies

VISUOSPATIAL PROCESSING & USN			
LoE	**Conclusion Statement**	**RCTs**	**References**

1a	**Cuing and strategy-based visual scanning training** may produce greater improvements in neglect than **conventional rehabilitation or visual scanning alone.**	3	Roy et al., 2024; Turgut et al., 2018; Toglia et al., 2009
1b	**Body awareness training added to task specific training** may produce greater improvements in neglect compared to **task specific training alone**.	1	Bang et al., 2015
1a	**Robot-assisted training with sensory feedback** may produce greater improvements in neglect than **conventional rehabilitation.**	2	Chen et al., 2021; Park et al., 2021
1a	There is mixed evidence about the effect of **mirror therapy** for improving neglect when compared to **sham or conventional therapy.**	3	Fong et al., 2023; Sim et al., 2022; Pandian et al., 2014
1a	**Contralesional sensory stimulation** may not have a difference in efficacy compared to **conventional rehabilitation or no treatment** for improving neglect.	3	Geiser et al., 2024; Sukumaran et al., 2020; Karner et al., 2019
2	**Eye tracking glasses with biofeedback** may not have a difference in efficacy compared to **conventional rehabilitation** for improving neglect.	1	Fanthome et al., 1995
1b	**Visuomotor feedback (rod balancing task) training** may not have a difference in efficacy compared to **a simple rod lifting task (from the non-neglected side)** for improving neglect.	1	Rossit et al., 2019
1b	**Visual perception motion tracking program** may not have a difference in efficacy compared to **cognitive rehabilitation** for improving neglect.	1	Kang et al., 2009
1a	**Visuomotor imagery training** may not have a difference in efficacy compared to **conventional rehabilitation** for improving neglect.	2	Park & Lee, 2015; Welfringer et al., 2011
1b	**Kinesthetic ability training** may not have a difference in efficacy compared to **conventional rehabilitation** for improving neglect.	1	Kutlay et al., 2018

NEGLECT- SPECIFIC ADLs

LoE	Conclusion Statement	RCTs	References
1a	**Cuing and strategy-based visual scanning training** may produce greater improvements in neglect-specific ADL compared to **conventional rehabilitation.**	2	Roy et al., 2024; Turgut et al., 2018
1b	There is mixed evidence about the effect of **mirror therapy** for improving neglect-specific ADL when compared to **sham or conventional therapy.**	2	Fong et al., 2023; Sim et al., 2022
1a	There is mixed evidence about the effect of **Robot-assisted training with sensory feedback** for improving neglect-specific ADL when compared to **conventional rehabilitation.**	2	Chen et al., 2021; Park et al., 2021
1b	**Visual perception motion tracking program** may not have a difference in efficacy compared to **cognitive rehabilitation** for improving neglect-specific ADL.	1	Kang et al., 2009

General ADLs			
LoE	**Conclusion Statement**	**RCTs**	**References**
1b	**Mirror training** may produce greater improvements in general ADL compared to **conventional rehabilitation**.	2	Sim et al., 2022; Pandian et al., 2014
1b	**Visuomotor feedback (rod balancing task) training** may produce greater improvements in general ADL compared to **a simple rod lifting task (from the non-neglected side).**	1	Rossit et al., 2019
1b	**Cuing and strategy-based visual scanning training** may produce greater improvements in general ADL compared to **conventional rehabilitation.**	1	Roy et al., 2024
1b	**Body awareness training added to task specific training** may produce greater improvements in general ADL compared to **task specific training alone**.	1	Bang et al., 2015
1b	There is mixed evidence about the effect of **Robot-assisted training with sensory feedback** for improving general ADL when compared to **conventional rehabilitation.**	1	Chen et al., 2021
1a	**Contralesional sensory stimulation** may not have a difference in efficacy compared to **conventional rehabilitation or no treatment** for improving general ADL.	2	Sukumaran et al., 2020; Karner et al., 2019
1b	**Visual perception motion tracking program** may not have a difference in efficacy compared to **cognitive rehabilitation** for improving general ADL.	1	Kang et al., 2009
1b	**Kinesthetic ability training** may not have a difference in efficacy compared to **conventional rehabilitation** for improving general ADL.	1	Kutlay et al., 2018

GLOBAL COGNITION			
LoE	**Conclusion Statement**	**RCTs**	**References**
1b	**Visual perception motion tracking programmes** may not have a difference in efficacy compared to **cognitive rehabilitation** for improving global cognition.	1	Kang et al., 2009

Key Points

Cuing and strategy-based visual scanning training, body awareness training combined with task specific training compared to task specific training, and robot-assisted training with sensory feedback may be beneficial for improving USN.

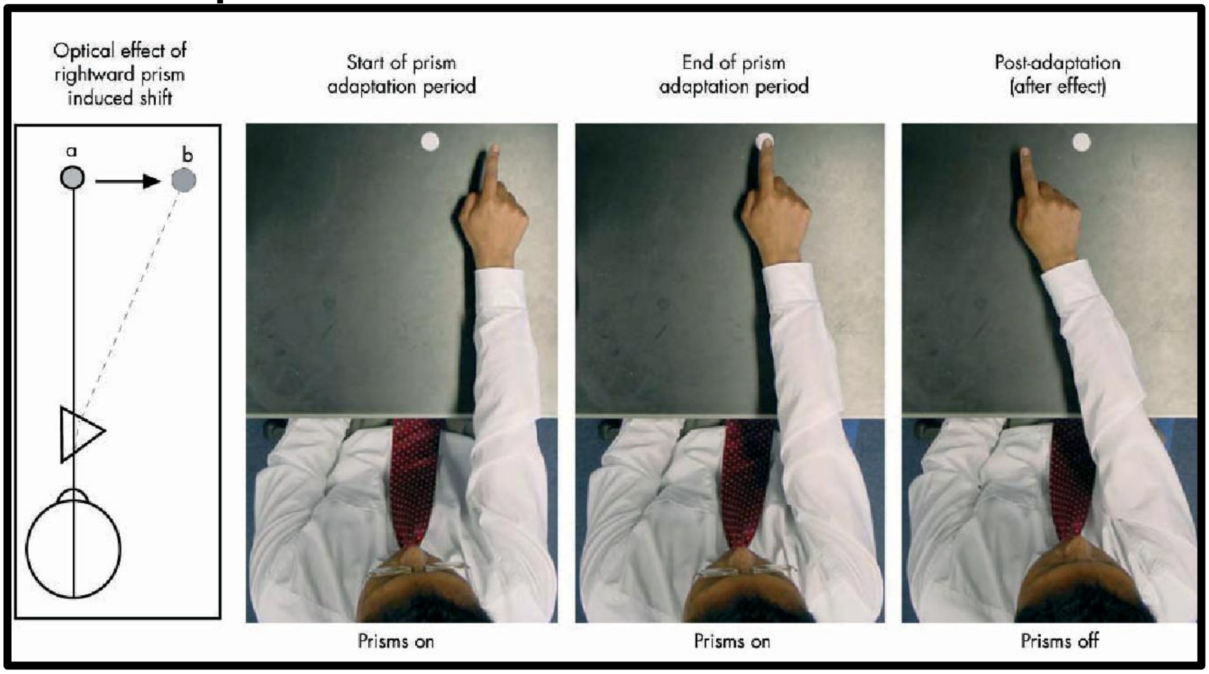
Eye tracking glasses with biofeedback, rod balancing task training, visual perception motion tracking program, visuomotor imagery training, and kinesthetic ability training may not be beneficial for improving USN; and mirror therapy and contra-lesional sensory stimulation showed mixed evidence for improving USN. However, the number of studies is very limited.

Cuing and strategy-based visual scanning training showed beneficial effects, mirror therapy and robot-assisted training with sensory feedback showed mixed effect, and visual perception motion tracking program did not show beneficial effects on improving neglect specific-ADLs. However, the number of studies is very limited.

Cuing and strategy-based visual scanning training, body awareness training combined with task specific training, mirror therapy, and rod balancing task training may be beneficial for improving general ADLs.

Contra-lesional sensory stimulation, visual perception motion tracking program, and kinesthetic ability training may not be beneficial for improving general ADLs. However, the number of studies is very limited.

Prism Adaptation Treatment



Adopted from: https://www.semanticscholar.org/paper/Hemispatial-neglect.-Parton-Malhotra/36a38a9a06727477354cdb0b6cbb5c43178365ff/figure/2

Prisms affect spatial representation by causing an optical deviation of the visual field to either the left or the right. One of the most common low vision interventions for stroke induced hemianopia is the incorporation of binocular sector prisms in the person's habitual spectacle lenses. These may be Fresnel membrane lenses or prisms that are cemented onto the lens surface. While wearing the prisms, an individual's visual field will be shifted in one direction. Importantly, the visuomotor system will adapt to this new deviation over time, understanding that the true location of the objects are not as they appear in the goggles. Once the prisms are removed, the participants will still be adapted to the visual deviation and will show a bias to one side for visuomotor behaviour. This forced deviation can help individuals with neglect attend better to the contralesional visual hemisphere.

Seventeen RCTs were found that evaluated prism adaptation interventions for neglect rehabilitation. Thirteen RCTs evaluated prism adaptation compared to conventional rehabilitation or sham prisms (Goedert et al., 2020; Jacquin-Courtois et al., 2010; Longley et al., 2023; Mancuso et al., 2012; Mizuno et al., 2011; Nys et al., 2008; Rode et al., 2015; Rossetti et al., 1998; Ten Brink et al., 2017; Turton et al., 2010; Umeonwuka et al., 2023; Vaes et al., 2018; Vilimovsky et al., 2021). One RCT (Facchin et al., 2021) compared prism adaptation to optokinetic stimulation. One RCT compared prims adaptation plus methylphenidate to prism adaptation with a placebo (Luauté et al., 2018). One RCT compared prism adaptation to visual scanning as well as to limb activation (Priftis et al., 2013). One RCT compared prism adaptation paired with functional electrical stimulation to prism adaptation alone and to functional electrical stimulation alone (Choi et al., 2019).

The methodological details and results of all 17 RCTs are presented in Table 5.

Table 5. RCTs evaluating prismatic adaptation interventions for neglect rehabilitation.

Authors (Year) Study Design (PEDro) Sample Size$_{start}$ Sample Size$_{end}$ Time post stroke	Interventions Duration: Session length, frequency per week for total number of weeks	Outcome Measures Result (direction of effect)
Prism Adaptation vs. Sham Prism/Conventional Rehabilitation		
Longley et al. (2023) RCT (5) N_{Start}=53 N_{End}=39 TPS=Acute	E: Prism adaptation + Standard occupational therapy C: Standard occupational therapy Duration: 5min/d, 5d/wk, for up to 3wks prism adaptation	• Heart Cancellation (-) • Star Cancellation (-) • Reading Test (-) • Kessler Foundation Neglect Assessment Process (-) • Nottingham Extended Activities of Daily Living Scale (-) • Patient Reported Evaluation of Cognitive State (-)
Umeonwuka et al. (2023) RCT (9) N_{Start}=74 N_{End}=68 TPS=Subacute	E: Prism adaptation treatment C: Sham prism adaption treatment Duration: 30min/d, 5d/wk, for 12 sessions over 16d	• Behavioural Inattention Test (+exp) ○ Line Crossing (+exp) ○ Star Cancellation (+exp) ○ Letter Cancellation (+exp) ○ Figure and Shape Copying (+exp) ○ Line Bisection Test (+exp), ○ Representational Drawing (-) • Catherine Bergego scale (+exp)
Vilimovsky et al. (2021) RCT (7) N_{Start}=34 N_{End}=23 TPS=Subacute	E: Prism adaptation treatment + multidisciplinary rehabilitation program C: Sham treatment + multidisciplinary rehabilitation program Duration: 15-20min/d, for 10d	• Catherine Bergego Scale (-) • Bells Test (-) • Line Bisection (-) • Scene Copying Test (-)
Goedert et al. (2020) RCT (4) N_{Start}=19 N_{End}=17 TPS=Subacute	E: Prism adaptation treatment + Standard care C: Standard care Duration: 15-20min/d, 5d/wk, for 2wks	• Catherine Bergego Scale (+exp) • Behavioural Inattention Test (-)
Vaes et al. (2018) RCT (5) N_{Start}=54 N_{End}=43 TPS=Subacute	E: Prism Adaptation C: Sham Prism Adaptation Duration: 7 sessions over 7-12d	• Visuospatial Neglect Test Battery: ○ Bells Test (-) ○ Diamond Cancellation (-) ○ Schenkenberg Test (-) ○ Coloured Rectangle Bisection (+exp) ○ Search Time Test (-) ○ Visuospatial Navigation Test (+exp) ○ Spatial Memory Test (+exp) ○ Clock Drawing Test (-) ○ Butterfly Drawing (+exp) ○ Extinction Test (+exp)
Ten Brink et al. 2017 RCT (8) N_{Start}=69 N_{End}=67 TPS=Subacute	E: Prism Adaptation + Standard Rehabilitation C: Sham Prism Adaptation + Standard Rehabilitation Duration: 5d/wk for 2wk	• Catherine Bergego Scale (-) • Mobility Assessment Course (-) • Shape Cancellation Task (-)
Rode et al. (2015) RCT (7) N_{Start}=20 N_{End}=18 TPS=Subacute	E: Prism Adaptation C: Placebo Prism Adaptation Duration: 6-10min, 1d/wk, 4wks	• Behavioural Inattention Test (-) • Functional Independence Measure (-)
Mancuso et al. (2012) RCT (4) N_{Start}=29 N_{End}=22 TPS=Subacute	E: Prism Adaptation Treatment C: Sham (Neutral Lenses) Duration: 30min/d, 5d/wk for 1wk	• Albert Test (-) • Line Cancellation Test (-) • Line Orientation Test (-) • Bell's Cancellation Test (-) • Behavioural Inattention Test

		○ Copying Drawings (-) ○ Finding Objects (-) ○ Dealing Playing Cards (-)
Mizuno et al. (2011) RCT (7) N_{Start}=38 N_{End}=34 TPS=Subacute	E: Prism Adaptation Therapy C: Sham Prism Adaptation Therapy Duration 40min/d, 5d/wk, for 2wks	• Behavioral Inattention Test (+exp) • Catherine Bergego Scale (-) • Functional Independence Measure (-)
Jacquin-Courtois et al. (2010) RCT (5) N_{Start}=12 N_{End}=12 TPS=Subacute * Auditory neglect	E: Prism Adaptation Treatment C: Sham Prism Adaptation (10°) Duration: 10min	• Dichotic Listening Task: ○ Number of Correct Responses (-) ○ Lateralization (+exp) ○ Number of Fusion Errors (+exp)
Turton et al. (2010) RCT (6) N_{Start}=36 N_{End} =34 TPS=Subacute	E: Prism Adaptation C: Sham Prism Adaptation Duration: 5d/wk for 2wk	• Behavioural Inattention Test (-) • Catherine Bergego Scale (-)
Nys et al. (2008) RCT (6) N_{Start}=16 N_{End} =16 TPS=Acute	E: Prism Adaptation Treatment C: Sham Prism Adaptation Treatment Duration: 4d	• Line Bisection Test (-) • Letter Cancellation (+exp) • Scene Copying task (+exp)
Rossetti et al. (1998) RCT (5) N_{Start}=12 N_{End} =12 TPS=Subacute Experiment 2 is reported	E: Prism Adaptation Treatment C: Sham Prism Adaptation Treatment Duration: 2-5min	• Line Bisection (+exp) • Line Cancellation (+exp) • Figure Copying (+exp)
Prism Adaptation vs. Optokinetic Stimulation		
Facchin et al. (2021) RCT (4) N_{Start}=13 N_{End}=13 TPS=Acute	E: Prism Adaptation Treatment C: Optokinetic Stimulation Duration: 10 sessions, 2x/d, for 5d	• Letter Cancellation (-) • Star Cancellation (-) • Figure Copy Drawing (-) • Sentence Reading (-) • Comb and Razor (-) • Line Bisection Test (-) • Clock Drawing Test (-)
Prism Adaptation + Methylphenidate		
Luaute et al. 2018 RCT (8) N_{Start}=24 N_{End} =21 TPS=Subacute	E: Prism Adaptation + Methylphenidate (10mg) C: Prism Adaptation + Placebo (10mg) Duration: 4 sessions Prism adaptation + Methylphenidate (or placebo), 2x/d for 4d	• Catherine Bergego Scale (+exp) • Line Bisection Test (-) • Line Cancellation (Albert Test) (-) • Balloon Test (-) • Scene Copying Test (-) • Star Cancellation Test (-) • Computerized Attention Assessment Battery: ○ Alert Test (-) ○ Sustained Attention (-) • Functional Independence Measure (+exp)
Prism Adaptation vs. Visual Scanning vs. Limb Activation		
Priftis et al. (2013) RCT (4) N_{Start}=33 N_{End}=31 TPS=Subacute	E1: Visual Scanning Training E2: Limb Activation Treatment C: Prism Adaptation Treatment Duration: 20min, 2x/d 5d/wk for 2wk	E1/E2 vs C • Comb and Razor Test (-) • Fluff Test (-) • Picture Scanning (-) • Menu Reading (-) • Coin Sorting (-) • Semi-structured Scale for the Functional Evaluation of Hemi-Inattention (-)

		• Room Description (-) • Catherine Bergego Scale (-)
Prism Adaptation + Functional Electrical Stimulation		
Choi et al. (2019) RCT (5) N_{Start}=30 N_{End}=30 TPS=Subacute	E1: Prism Adaptation Treatment + Functional Electrical Stimulation (FES) E2: Prism Adaptation Treatment C: FES Duration: 50min/d, 5d/wk, for 3wks	E1/E2 v C • Albert Test (+exp1) • Motor-free Visual Perception Test (+exp1) • Catherine Bergego Scale (+exp1) E1 v E2 • Albert Test (+exp1) • Motor-free Visual Perception Test (+exp1), • Catherine Bergego Scale (+exp1)

Abbreviations and table notes: C=control group; D=days; E=experimental group; H=hours; Min=minutes; RCT=randomized controlled trial; TPS=time post stroke category (Acute: less than 30 days, Subacute: more than 1 month but less than 6 months, Chronic: over 6 months); Wk=weeks.
+exp indicates a statistically significant between groups difference at α=0.05 in favour of the experimental group
+exp_2 indicates a statistically significant between groups difference at α=0.05 in favour of the second experimental group
+con indicates a statistically significant between groups difference at α=0.05 in favour of the control group
- indicates no statistically significant between groups differences at α=0.05

Conclusions about prism adaptation treatment

VISUOSPATIAL PROCESSING & USN			
LoE	**Conclusion Statement**	**RCTs**	**References**
1a	The use of **prism adaptation therapy** for improving neglect may not be different in efficacy when compared to **conventional rehabilitation/sham**.	13	Goedert et al., 2020 Jacquin-Courtois et al., 2010 Longley et al., 2023 Mancuso et al., 2012 Mizuno et al., 2011 Nys et al., 2008 Rode et al., 2015 Rossetti et al.,1998 Ten Brink et al., 2017 Turton et al., 2010 Umeonwuka et al., 2023 Vaes et al., 2018 Vilimovsky et al., 2021
2	**Prism adaptation therapy** may not be more effective than **optokinetic stimulation** for the improvement of neglect.	1	Facchin et al., 2021
1b	**Prism adaptation with methylphenidate** may not have a difference in efficacy compared to **prism adaptation alone** for improving neglect.	1	Luaute et al., 2018
2	**Prism adaptation** may not have a difference in efficacy compared to **visual scanning** or **limb activation** for improving neglect.	1	Prifitis et al., 2013
2	**Prism adaptation with functional electrical stimulation** may produce greater improvements in neglect than **prism adaptation** or **functional electrical stimulation alone.**	1	Choi et al., 2019

NEGLECT- SPECIFIC ADLs			
LoE	**Conclusion Statement**	**RCTs**	**References**
1a	**Prism adaptation** may not produce greater improvements in neglect-specific ADLs than **conventional rehabilitation/sham**.	6	Goedert et al., 2020 Longley et al., 2023 Mizuno et al., 2011 Ten Brink et al., 2017 Turton et al., 2010 Umeonwuka et al., 2023

2	**Prism adaptation therapy** may not be more effective than **optokinetic stimulation** for the improvement of neglect-specific ADLs.	1	Facchin et al., 2021
1b	**Prism adaptation with methylphenidate** may be more effective than **prism adaptation alone** for the improvement of neglect-specific ADLs.	1	Luaute et al., 2018
2	**Prism adaptation** may not be more effective than **visual scanning** or **limb activation** for improving neglect-specific ADLs.	1	Prifitis et al., 2013
2	**Prism adaptation with functional electrical stimulation** may produce greater improvements in neglect-specific ADLs than **prism adaptation** or **functional electrical stimulation alone.**	1	Choi et al., 2019

GENERAL ADLs			
LoE	**Conclusion Statement**	**RCTs**	**References**
1a	**Prism adaptation** may not have a difference in efficacy compared to **conventional rehabilitation/sham** for improving general ADLs.	3	Longley et al., 2023 Mizuno et al., 2011 Rode et al., 2015
1b	**Prism adaptation with methylphenidate** may be more effective than **prism adaptation alone** for the improvement of general ADLs.	1	Luaute et al., 2018

GLOBAL COGNITION			
LoE	**Conclusion Statement**	**RCTs**	**References**
2	**Prism adaptation** may not have a difference in efficacy compared to **conventional rehabilitation/sham** for improving global cognition.	1	Longley et al., 2023
1b	**Prism adaptation with methylphenidate** may be not more effective than **prism adaptation alone** for the improvement of global cognition.	1	Luaute et al., 2018

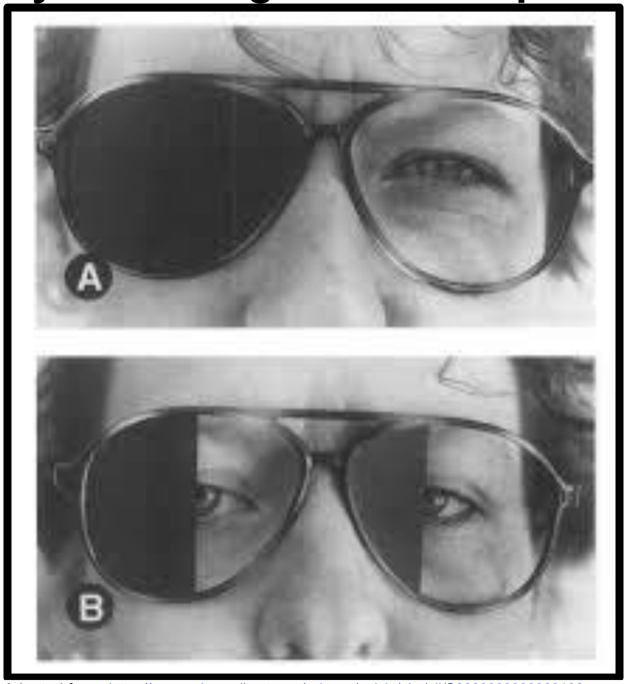
Key Points

Prism adaptation may not be beneficial for improving USN, neglect-specific ADLs, general ADLs, and global cognition when compared to conventional rehabilitation.

Prism adaptation combined with functional electrical stimulation may be beneficial for improving USN and neglect-specific ADLs when compared to either therapy alone.

Methylphenidate added to prism adaptation may not be beneficial for improving USN or global cognition but may be beneficial for improving neglect-specific or general ADLs, when compared to prism adaptation alone.

Eye-Patching and Hemi-spatial Glasses



Adapted from: https://www.sciencedirect.com/science/article/abs/pii/S0003999399903106

Eye-patching is an interesting approach to hemispatial neglect rehabilitation that has been proposed since the early 1990s as a method to improve visual-scanning and attend to the neglected field (Butter & Kirsch, 1992). Beis et al. (1999) stated that their "*hypothesis was that eye patches can be used to alter the processing of visual information by affecting the information processing structures of the central nervous system*". Shulman noted that in healthy subjects, eye patches should increase eye movements towards the contralateral space (Shulman, 1984). Thus, eye patching of the eye ipsilateral to the lesion causes patients to look toward contralateral space by either moving their eye or by movement of the head. In turn these effects, as cited by Beis et al. (1999), *"encourage the development of voluntary, deliberate control of attention in the short term and the development of automatic shifts of attention over the longer term,"* (Beis et al., 1999; Seron et al., 1989).

Nine RCTs were found evaluating eye patching interventions for neglect rehabilitation. Four RCTs compared eye patching to conventional rehabilitation (Beis et al., 1999; Machner et al., 2014; Tsang et al., 2009; Zeloni et al., 2002). One RCT compared eye patching to visual scanning (Ianes et al., 2012). Two RCTs compared eye patching with cognitive rehabilitation training to cognitive rehabilitation training alone (Aparicio-Lopez et al., 2015; Aparicio-López et al., 2016). One RCT compare eye patching with constraint induced movement therapy to constraint induced movement therapy alone (Wu et al., 2013). One RCT compared eye patching with trunk rotation therapy to conventional rehabilitation (Fong et al., 2007).

The methodological details and results of all 9 RCTs are presented in Table 6.

Table 6. RCTs evaluating eye-patching and hemi-spatial glasses interventions for neglect rehabilitation.

Authors (Year) Study Design (PEDro) Sample Size$_{start}$ Sample Size$_{end}$ Time post stroke	Interventions Duration: Session length, frequency per week for total number of weeks	Outcome Measures Result (direction of effect)
Eye Patching vs. Conventional Rehabilitation		
Machner et al. (2014) RCT (6) N_{Start}=23 N_{End}=21 TPS=Acute	E: Hemifield Eye Patching and Repetitive Optokinetic Stimulation (15min/d) + Usual Care C: Usual Care Duration: 7d	• Catherine Bergego Scale (-) • Bell's Cancellations Test (-) • Star Cancellation Test (-) • Line Bisection Test (-) • Ogden Figure Copying Task (-) • Reading Errors (-) • Barthel Index (-) • Modified Rankin Scale (-)
Tsang et al. (2009) RCT (7) N_{Start}=35 N_{End}=34 TPS=Acute	E: Conventional Occupational Therapy + Right Half-field Eye Patching C: Occupational Therapy Duration: 1hr/d, 5d/wk, 4wks	• Behavioural Inattention Test - Conventional Subtest (+exp) • Functional Independence Measure (-)
Zeloni et al. (2002) RCT (3) N_{Start}=11 N_{End}=11 TPS=Chronic & Subacute	E: Goggles with Right Hemisphere Occlusion + Standard Neglect Rehabilitation C: Standard Neglect Rehabilitation Duration: 1wk	• Albert's Test (+exp) • Letter Cancellation (-) • Bell's Cancellation (-) • Line Bisection (-) • Figure Drawing 1 (-) • Figure Drawing 2 (-)
Beis et al. (1999) Cross-over RCT (2) N_{Start}=22 N_{End}=22 TPS=Subacute	E1: Right Half-field Patches Over Both Eyes E2: Complete eye patches C: No Patch Duration: 12hr/d, 3mo	E1/E2 v C: • Functional Independence Measure: (+exp1) • Eye movement: • Time in Left Hemifield (-) • Leftward Eye Movements (+exp1)
Eye Patching vs. Visual Scanning Training		
Ianes et al. (2012) RCT (7) N_{Start}=18 N_{End}=18 TPS=Acute	E: Right Half-field Eye Patching (8hr/d) C: Visual Scanning Training (40min/d) Duration: 8hr/d, for 15d patching; 40min/d, 5d/wk, 3wks	• Line Bisection Test (-) • Line Crossing Test (-) • Bell's Cancellation Test (-)
Eye Patching + Cognitive Rehabilitation		
Aparicio-Lopez et al. (2016) RCT (5) N_{Start}=28 N_{End}=28 TPS=Subacute	E: Right Hemifield Eye Patching + Computerized Cognitive Rehabilitation C: Computerized Cognitive Rehabilitation Duration: 15 one-hour sessions, mean 2.71 sessions/wk	• Bell Cancellation test (-) • Ogden Figure Copying (-) • Line Bisection percent positively for rightward deviations (-) • Line Bisection percent negatively for leftward deviations (-) • Line Bisection lines omitted (-) • Baking Tray Task-Left (-) • Baking Tray Task-Right (-) • Reading Task (-) • Catherine Bergego Scale-Self (-)

		• Catherine Bergego Scale-Rater (-)
Aparicio-Lopez et al. (2015) RCT (6) N_{Start}=12 N_{End}=12 TPS=Subacute	E: Computer-based Cognitive Rehabilitation + Right Hemifield Eye Patching C: Computer-based Cognitive Rehabilitation Duration: 1hr/d, 5d/wk for 3wk	• Line Bisection Test (-) • Bell's Cancellation Test (-) • Ogden Figure Copying of (-) • Baking Tray Task (-) • Catherine Bergego Scale (-) • Reading Test (+exp)
Eye Patching + Constraint Induced Therapy		
Wu et al. (2013) RCT (7) N_{Start}=27 N_{End}=24 TPS = Chronic	E1: Constraint Induced Therapy (6hr/d) + eye patching E2: Constraint Induced Therapy C: Conventional Rehabilitation (2hr/d) Duration:5d/wk for 3wks	E1 vs E2 • Catherine Bergego Scale (-) • Eye Movement Variables: o Number of Left Fixation Points (+exp2) o Fixation Amplitude (-) o Left Fixation Time (-) E1/E2 vs C • Catherine Bergego Scale (+exp1; +exp2) • Eye Movement Variables: o Number of Left Fixation Points (+exp2; +con), o Fixation Amplitude (-) o Left Fixation Time (-) o Trunk Lateral Shift (-)
Eye Patching + Trunk Rotation Therapy		
Fong et al. (2007) RCT (6) N_{Start}=60 N_{End}=54 TPS=Acute	E1: Voluntary Trunk Rotation + Right Hemifield Eye Patching E2: Voluntary Trunk Rotation C: Conventional Rehabilitation Duration: 1hr/d, 5d/wk, 4wks	E1/E2 vs C • Behavioural Inattention Test: o Conventional (-) o Behavioural (-) • Clock Drawing Test (-)

Abbreviations and table notes: C=control group; D=days; E=experimental group; H=hours; Min=minutes; RCT=randomized controlled trial; TPS=time post stroke category (Acute: less than 30 days, Subacute: more than 1 month but less than 6 months, Chronic: over 6 months); Wk=weeks.
+exp indicates a statistically significant between groups difference at α=0.05 in favour of the experimental group
+exp_2 indicates a statistically significant between groups difference at α=0.05 in favour of the second experimental group
+con indicates a statistically significant between groups difference at α=0.05 in favour of the control group
- indicates no statistically significant between groups differences at α=0.05

Conclusions about eye patching and hemi-spatial glasses

VISUOSPATIAL PROCESSING & USN			
LoE	**Conclusion Statement**	**RCTs**	**References**
1a	**Eye patching** may not have a difference in efficacy compared to **conventional rehabilitation** for improving neglect.	4	Machner et al., 2014; Tsang et al., 2009; Zeloni et al., 2002; Beis et al., 1999
1b	**Eye patching** may not have a difference in efficacy compared to **visual scanning** for improving neglect.	1	Ianes et al., 2012
1b	**Eye patching with cognitive rehabilitation** may not have a difference in efficacy compared to **cognitive rehabilitation alone** for improving neglect.	2	Aparicio-Lopez et al., 2015; Aparicio-Lopez et al., 2015
1b	**Constraint induced therapy with eye patching** may not have a difference in efficacy compared to **conventional rehabilitation or constraint induced therapy alone** for improving neglect.	1	Wu et al., 2013
1b	**Eye patching with trunk rotation therapy** may not have a difference in efficacy compared to **conventional rehabilitation** for improving neglect.	1	Fong et al., 2007

NEGLECT- SPECIFIC ADLs			
LoE	**Conclusion Statement**	**RCTs**	**References**
1b	**Eye patching** may not have a difference in efficacy compared to **conventional rehabilitation** for improving neglect-specific ADLs.	1	Machner et al., 2014
1b	**Eye patching with cognitive rehabilitation** may not have a difference in efficacy compared to **cognitive rehabilitation alone** for improving neglect-specific ADLs.	2	Aparicio-Lopez et al., 2015; Aparicio-Lopez et al., 2015
1b	**Constraint induced therapy with eye patching** may not have a difference in efficacy compared to **constraint induced therapy alone** for improving neglect-specific ADLs.	1	Wu et al., 2013
1b	**Constraint induced therapy with eye patching** may produce greater improvements in neglect-specific ADLs than **conventional rehabilitation**.	1	Wu et al., 2013

GENERAL ADLs			
LoE	**Conclusion Statement**	**RCTs**	**References**
1a	**Eye patching** may not have a difference in efficacy compared to **conventional rehabilitation** for improving general ADLs.	3	Machner et al., 2014; Tsang et al., 2009; Beis et al., 1999

Key Points

Eye patching may not be beneficial for improving USN, neglect specific ADLs, and general ADLs, alone or as an adds-on therapy, when compared to conventional rehabilitation.

Postural and Trunk Rotation Trainings

Adapted from: https://journals.sagepub.com/doi/abs/10.1177/0269215507076391?journalCode=crea and https://www.archives-pmr.org/article/S0003-9993(97)90236-7/pdf

Trunk impairment is common after stroke and is directly associated with balance and gait (Jijimol et al., 2013; Verheyden et al., 2006). It has been proposed that the orientation of the trunk midline in space functions as the dividing line between our personal representation of left versus right space and acts as an anchor for the calculation of body position (Karnath et al., 1991). Karnath et al. (1993) demonstrated that turning only the trunk of the patient to the left such that both right and left stimuli were projected to the right side of the trunk could compensate for deficits in reaction times to stimuli in the left visual field. By shifting the midline, the individual is artificially manipulating their internal reference point and modifying their egocentric reference frames.

Four RCTs were found evaluating trunk rotation therapy interventions for neglect rehabilitation. Two RCTs examined the effect of a postural rehabilitation device (Bon Saint Come device) (de Sèze et al., 2001; Wiart et al., 1997). One RCT assessed the results of pen-and-pencil USN tests in different body positions, supine, sitting, and standing (Onaka et al., 2022).

The methodological details and results of the 4 RCTs are presented in Table 7.

Table 7. RCTs evaluating trunk rotation therapy interventions for neglect rehabilitation.

Authors (Year) **Study Design (PEDro)** **Sample Size$_{start}$** **Sample Size$_{end}$** **Time post stroke**	**Interventions** **Duration: Session length, frequency per week for total number of weeks**	**Outcome Measures** **Result (direction of effect)**
Bon Saint Come Device vs. Conventional Rehabilitation		
Wiart et al. (1997) RCT (6) N_{Start}=22 N_{End}=22 TPS=Subacute	E: Bon Saint Come Trunk Training (Trunk Rotation control while doing Visual Scanning) + Traditional Rehabilitation C: Traditional Rehabilitation Duration: 1hr/d, 5d/wk for 4wks	• Schekenberg Test (+exp) • Bell's Cancellation Test (+exp) • Albert Test (+exp) • Functional Independence Measure (+exp)
DeSeze et al. (2001) RCT (6) N_{Start}=20	E: Saint Come Device (Postural rehablitation device) + Conventional Neurorehabilitation C: Conventional Neurorehabilitation	• Static Postural Status (-) • Trunk Control Test (+exp) • Upright Equilibrium Index (+exp) • Sitting Equilibrium Index (+exp)

N_{End}=20 TPS=Subacute	Duration: Device 1hr/d 2mo Conventional Neurorehabilitation - 1 hr/d, 2mo	• Improvement in Neglect (+exp) • Gait Recovery (+exp) • Average Functional Ambulation Classification (+exp) • Functional Independence Measure (-) • Bells Test (+exp)
Trunk Rotation Therapy + Eye Patching		

Fong et al. (2007)
RCT (6)
N_{Start}=60
N_{End}=54
TPS=Acute
	E1: Voluntary Trunk Rotation + Right Hemifield Eye Patching
	E2: Voluntary Trunk Rotation
	C: Conventional Rehabilitation
	Duration: 1hr/d, 5d/wk, 4wks
		E1/E2 vs C
		• Behavioural Inattention Test:
		  ○ Conventional (-)
		  ○ Behavioural (-)
		• Clock Drawing Test (-)

Different body positions		
Onaka et al. (1997) RCT (5) N_{Start}=20 N_{End}=20 TPS=Subacute	E1: Supine position E2: Standing position C: Sitting position Duration: Not reported	E1/E2 v C • Bells Test (+exp1, +exp2) • Line Bisection Test (+exp1, +exp2) • Scene Copy Test (+exp1, +exp2) • Star Cancellation (+exp1, +exp2) E1 v E2 • Bells Test (-) • Line Bisection Test (-) • Scene Copy Test (-) • Star Cancellation (-)

Abbreviations and table notes: C=control group; D=days; E=experimental group; H=hours; Min=minutes; RCT=randomized controlled trial; TPS=time post stroke category (Acute: less than 30 days, Subacute: more than 1 month but less than 6 months, Chronic: over 6 months); Wk=weeks.
+exp indicates a statistically significant between groups difference at α=0.05 in favour of the experimental group
+exp2 indicates a statistically significant between groups difference at α=0.05 in favour of the second experimental group
+con indicates a statistically significant between groups difference at α=0.05 in favour of the control group
- indicates no statistically significant between groups differences at α=0.05

Conclusions about trunk rotation therapy

VISUOSPATIAL PROCESSING & USN			
LoE	**Conclusion Statement**	**RCTs**	**References**
1b	**Trunk rotation combined with eye patching** may not have a difference in efficacy compared to **conventional rehabilitation or trunk rotation alone** for improving neglect.	1	Fong et al., 2007
1a	**Bon Saint Come trunk training device** may produce greater improvements in neglect than **conventional rehabilitation** for improving neglect.	2	Wiart et al., 1997; DeSeze et al., 2001
1b	Supine and standing positions my produce beneficial effect on the pen-and-pencil USN assessment results compared to sitting position.	1	DeSeze et al., 2001

GENERAL ADLs			
LoE	**Conclusion Statement**	**RCTs**	**References**
1b	**Trunk rotation combined with eye patching** may not have a difference in efficacy compared to **conventional rehabilitation or trunk rotation alone** for improving general ADL.	1	Fong et al., 2007
1a	There is mixed evidence about the effect of **Bon Saint Come trunk training device** for improving general ADL when compared to **conventional rehabilitation.**	2	Chen et al., 2021; Park et al., 2021

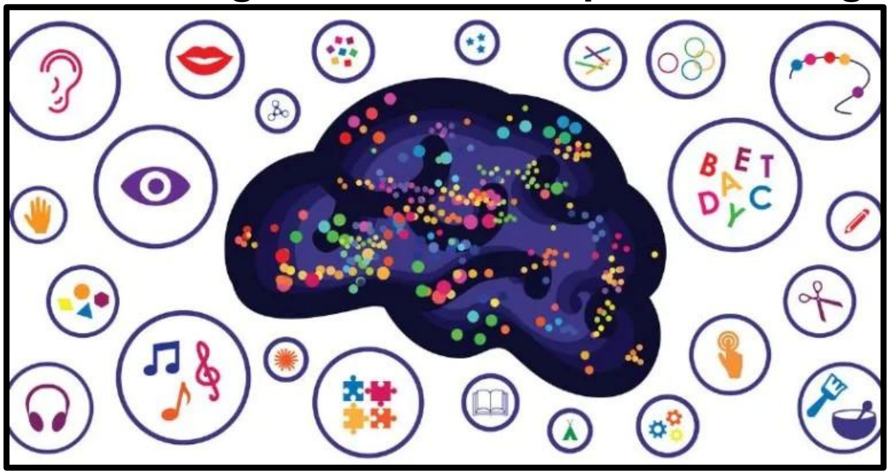
Key Points

Bon Saint Come trunk training device compared to conventional rehabilitation may be beneficial for improving USN, but the evidence is mixed regarding it effect on general ADLs.

Individuals with neglect may have better performance on neglect assessment tests in the supine and standing position compared to the sitting position.

Trunk rotation therapy combined with eye-patching may not be beneficial for improving USN and general ADLs, compared to eye-patching alone or conventional rehabilitation.

General Cognitive and Perceptual Training



Adapted from: https://www.rehabmart.com/post/25-tools-every-occupational-therapist-needs

Neglect is frequently associated with multiple deficits including problems with sustained attention and arousal, as well as motor and sensory impairments (Barrett et al., 2006). General cognitive and perceptual training interventions consist of treatments that target deficits associated with neglect such as selective attention, perceptual training, cueing therapy and music therapy. These interventions train aspects of cognition and perception that are affected by hemispatial neglect caused by stroke. It is thought that by training these aspects of cognition and perception there will be improvements in neglect outcomes as well.

Seven RCTs were found evaluating general cognitive and perceptual training interventions for neglect rehabilitation. Two RCTs compared computer-based cognitive training (Robertson et al., 1990; Svaerke et al., 2019). One RCT compared to approaches to perceptual training, transfer to training and functional approach (Edmans et al., 2000). One RCT compared perceptual training to conventional rehabilitation (Lincoln et al., 1985). One RCT examined music therapy compared to sham (Chen et al., 2013). One RCT examined movement cognitive therapy using brain gym exercises compared to routine rehabilitation (Anand et al., 2022). One RCT examined a multicomponent intervention that incorporated both motor and cognitive rehabilitation approaches and compared it to conventional rehabilitation (Wen et al., 2019).

The methodological details and results of the 7 RCTs are presented in Table 8.

Table 8. RCTs evaluating general cognitive and perceptual training interventions for neglect rehabilitation.

Authors (Year) Study Design (PEDro) Sample Size$_{start}$ Sample Size$_{end}$ Time post stroke	**Interventions Duration: Session length, frequency per week for total number of weeks**	**Outcome Measures Result (direction of effect)**
Computer based cognitive training vs Conventional Therapy		
Svaerke et al. (2019) RCT Crossover (5) N_{Start}=18 N_{End}=14 TPS=Acute	E: Early intervention of computer-based cognitive rehabilitation (CBCR) followed by usual care C: Usual Care followed by CBCR Duration: 30-45 min/d, every second day for 3wks of CBCR & 3wks of usual care	• Cognitive Assessment at Bedside with iPad (-) ○ Butterfly Test (-) • Drawing Test (-) • Wechsler Adult Intelligence Scale-IV ○ Block design test (-) • Street Completion Test (-)

Robertson et al. (1990) RCT (6) N_{Start} =36 N_{End} =33 TPS=Not Reported	E: Computer cognitive cognitive rehabilitation with scanning tasks C: Recreational Computer activity Duration: 45min/d, 3d/wk for 4wk	• Behavioural Inattention Test (-) • Rey-Osterreith Test (-) • Neale Reading Test (-) • Letter Cancellation Test (-) • Rey-Osterreith Test (-)
Transfer of Training Approach versus Functional Approach for Perceptual Training		
Edmans et al. (2000) RCT (7) N_{Start}=80 N_{End}=79 TPS=Subacute	E: Perceptual Training (Transfer of Training Approach) C: Perceptual Training (Functional Approach) Duration: 2.5hr/wk, 6wks	• Rivermead Perceptual Assessment Battery (-) • Barthel Index (-) • Edmans ADL Index (-)
Perceptual Retraining vs Conventional Therapy		
Lincoln et al. (1985) RCT (5) N_{Start}=33 N_{End}=33 TPS=Subacute	E: Perceptual retraining C: Conventional Therapy Duration: 4hrs/wk, 4wks	• Rivermead Perceptual Assessment Battery (-) • Activities of Daily Living Questionnaire (-)
Music Therapy vs Sham		
Chen et al. (2013) RCT crossover (3) N_{Start}=19 N_{End}=19 TPS=Chronic	E1: Pleasant music (attention) E2: Unpleasant music C: White noise (sham) Duration: 1min/1session	E1 v E2/C • Star Cancellation Test (+exp1) • Line Bisection Test (-) • Picture Scanning Test (+exp1)
Multicomponent Therapy vs Conventional Therapy		
Wen et al. (2019) RCT (5) N_{Start}=46 N_{End}=46 TPS=Acute	E: Multicomponent Treatment (Sensory Stimuli, Trunk Rotation Training, Visual Training, Suggestive Therapy, Environment Change, Occupational Therapy, Horticultural Therapy) + Routine Rehabilitation C: Routine Rehabilitation Duration: 30min/d	• Shenckenberg test (+exp) • Albert test (+exp) • Clock drawing test(+exp) • Copy drawing test (+exp) • Modified Barthel Index (+exp) • Functional Independence Measure (+exp)
Movement Cognitive Therapy vs Conventional Therapy		
Anand et al. (2022) RCT (5) N_{Start}=80 N_{End}=80 TPS=Subacute	E: Brain Gym Exercises (cross crawls, grounder, balance buttons, hook ups, neck rolls, owl, arm activation, gravity glider, rocker, lazy 8's, alphabet 8's and double doodle) C: Conventional Treatment Duration: 30min/d, 5d/wk, 4wks	• Catherine Bergego Scale (-) • Kessler foundation neglect assessment process (-) • Albert test (-) • Star cancellation test (-) • Single /double letter cancellation test (-) • Bell's test (-)

Abbreviations and table notes: C=control group; D=days; E=experimental group; H=hours; Min=minutes; RCT=randomized controlled trial; TPS=time post stroke category (Acute: less than 30 days, Subacute: more than 1 month but less than 6 months, Chronic: over 6 months); Wk=weeks.
+exp indicates a statistically significant between groups difference at α=0.05 in favour of the experimental group
+exp$_2$ indicates a statistically significant between groups difference at α=0.05 in favour of the second experimental group
+con indicates a statistically significant between groups difference at α=0.05 in favour of the control group
- indicates no statistically significant between groups differences at α=0.05

Conclusions about general cognitive and perceptual training

VISUOSPATIAL PROCESSING & USN			
LoE	**Conclusion Statement**	**RCTs**	**References**
1b	**Computer-based cognitive training** may not have a difference in efficacy compared to **standard care** for improving neglect.	2	Svaerke et al., 2019; Robertson et al., 1990
1b	The **Perceptual Training Transfer of Training Approach** may not have a difference in efficacy compared to **Perceptual Training Functional Approach** for improving neglect.	1	Edmans et al., 2000

2	**Perceptual Training** may not have a difference in efficacy compared to **Conventional Therapy** for improving neglect.	1	Lincoln et al., 1985
2	**Music Therapy** may be effective for the improvement of neglect, compared to **Sham Therapy**.	1	Chen et al., 2013
2	**Multicomponent Therapy** may be more effective than **Conventional Therapy** for improving neglect.	1	Wen et al., 2019
2	**Movement Cognitive Therapy** may not be more effective than **Conventional Therapy** for improving neglect.	1	Anand et al., 2022

NEGLECT- SPECIFIC ADLs			
LoE	**Conclusion Statement**	**RCTs**	**References**
2	**Movement Cognitive Therapy** may not be more effective than **Conventional Therapy** for improving neglect-specific ADLs.	1	Anand et al., 2022

GENERAL ADLs			
LoE	**Conclusion Statement**	**RCTs**	**References**
1b	**The Perceptual Training Transfer of Training Approach** is no more effective than the **Perceptual Training Functional Approach** for the improvement of general ADLs.	1	Edmans et al., 2000
2	**Perceptual Training** may not have a difference in efficacy compared to **Conventional Therapy** for the improvement of general ADLs.	1	Lincoln et al., 1985
2	**Multicomponent Therapy** may be more effective than **Conventional Therapy** for the improvement of general ADLs.	1	Wen et al., 2019

GLOBAL COGNITION			
LoE	**Conclusion Statement**	**RCTs**	**References**
1b	**Computer-based cognitive training** may not have a difference in efficacy compared to **standard care** for improving global cognition.	2	Svaerke et al., 2019; Robertson et al., 1990

Key Points

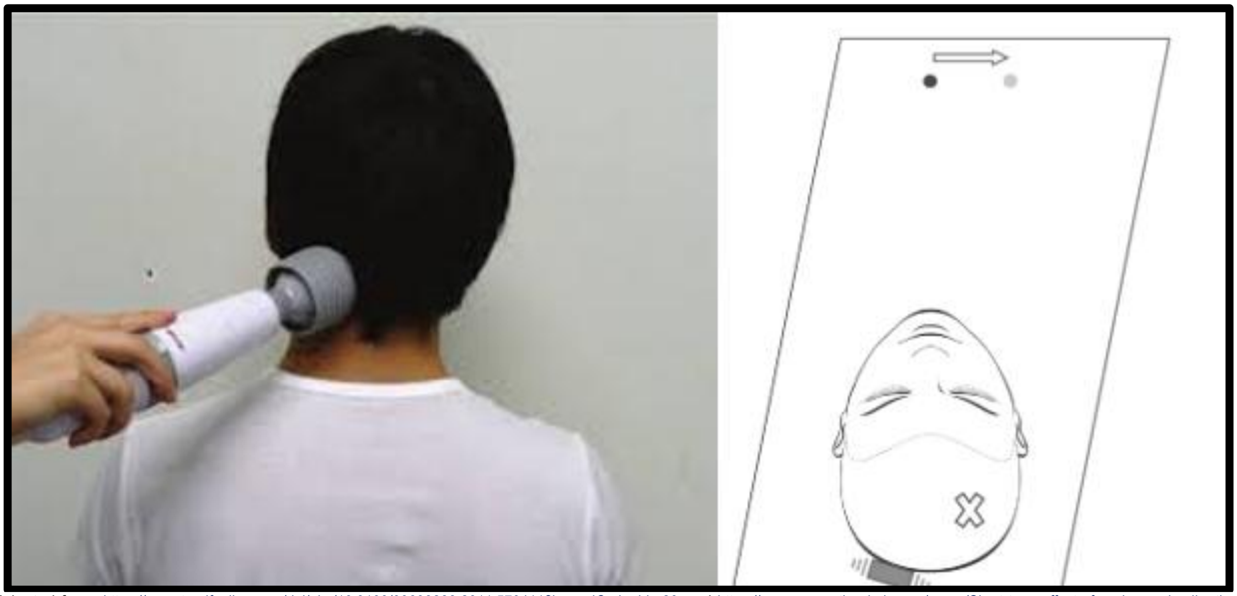
Computer-based cognitive training may not be beneficial for improving USN.

Perceptual training may not be beneficial for improving USN and general ADLs.

Music therapy and multi-component cognitive attention treatment may be beneficial for improving USN and general ADLs when compared to conventional/sham therapy.

Stimulation Interventions

Neck Stimulation



Adapted from: https://www.tandfonline.com/doi/abs/10.3109/09638288.2011.570411?journalCode=idre20 and https://www.semanticscholar.org/paper/Short-term-effect-of-neck-muscle-vibration-on-in-Leplaideur-Leblong/f07328c742e1f2a5e2451b4d4aac5e3231e22ef5/figure/0

Karnath et al. (1993) demonstrated that the detection and identification of stimuli in the left visual field in patients with neglect could be improved by trunk rotation, resulting in the lengthening of left posterior neck muscles, or by somatosensory stimulation applied to the left posterior neck muscles in the form of neck muscle vibration. Neck muscle vibration is thought to improve neglect by creating a kinaesthetic illusion, whereby a spot of light will appear to move in the opposite direction of stimulation (Leplaideur et al., 2016). It is non-invasive, has no side-effects and is easy to apply (Schindler et al., 2002). This somatosensory stimulation can also increase awareness of the neglected hemifield, providing a cue of sorts to attend more to that side of the body.

Three RCTs was found evaluating neck muscle vibration interventions for neglect rehabilitation. One RCT compared visual exploration training and neck muscle vibration to visual exploration alone (Schindler et al., 2002). One RCT was found evaluating neck muscle taping for neglect rehabilitation and compared it to placebo (Varalta et al., 2019). One RCT compared neck vibration with prism adaptation to neck vibration alone (Choi et al., 2022).

The methodological details and results of the 3 RCTs are presented in Table 9.

Table 9. RCTs evaluating neck muscle vibration therapy interventions for neglect rehabilitation.

Authors (Year) Study Design (PEDro) Sample Size$_{start}$ Sample Size$_{end}$ Time post stroke	**Interventions Duration: Session length, frequency per week for total number of weeks**	**Outcome Measures Result (direction of effect)**
Neck Vibration + Visual Exploration		
Schindler et al. (2002) Cross-over RCT (3) N_{Start}=20 N_{End}=20 TPS=Subacute	E: Visual Exploration Training + Neck Muscle Vibration C: Visual Exploration Training Duration: 40min/d, 5d/wk for 3wks	• Visual Subjective Straight-ahead Judgements (+exp) • Cancellation Test (+exp) • Tactile Search (+exp) • Indented Text Reading (+exp) • Visual Size Discrimination (-)

		• ADL Questionnaire (+exp)
Neck Vibration + Prism Adaptation		
Choi et al. (2022) RCT (6) N_{Start}=36 N_{End}=36 TPS=Chronic	E1: Prism adaptation + Neck vibration + Conventional therapy E2: Neck vibration + Conventional therapy C: Prism adaptation + Conventional therapy Duration: 50min/d, 5d/wk for 4wks	E1/E2 vs C • Albert's Test (+exp1) • Catherine Bergego Scale (+exp1) • Modified Barthel Index (-) E1 vs E2 • Albert's Test (+exp1) • Catherine Bergego Scale (+exp1) • Modified Barthel Index (-)
Neck Taping vs. Sham		
Varalta et al. (2019) RCT (9) N_{Start}=12 N_{End}=12 TPS=Chronic	E: Neck Taping using Kenzo Kase's Kinesio Taping Method C: Sham Neck Taping Duration: Tape replaced every 4d, total of 30d of treatment	• Star Cancellation Test (-) • Letters Cancellation Test (-) • Comb and Razor Test (-) • Cervical Joint Position Error Test (+exp)

Abbreviations and table notes: C=control group; D=days; E=experimental group; H=hours; Min=minutes; RCT=randomized controlled trial; TPS=time post stroke category (Acute: less than 30 days, Subacute: more than 1 month but less than 6 months, Chronic: over 6 months); Wk=weeks.
+exp indicates a statistically significant between groups difference at α=0.05 in favour of the experimental group
+exp_2 indicates a statistically significant between groups difference at α=0.05 in favour of the second experimental group
+con indicates a statistically significant between groups difference at α=0.05 in favour of the control group
- indicates no statistically significant between groups differences at α=0.05

Conclusions about neck muscle vibration

VISUOSPATIAL PROCESSING & USN			
LoE	**Conclusion Statement**	**RCTs**	**References**
2	**Visual exploration with neck muscle vibration** may produce greater improvements in neglect than **visual exploration alone**.	1	Schindler et al., 2002
1b	**Neck muscle taping** may not have a difference in efficacy compared to **sham taping** for improving neglect.	1	Varaltra et al. 2019
1b	**Neck vibration with prism adaptation** may produce greater improvements in neglect than **neck vibration alone**.	1	Choi et al., 2022

NEGLECT- SPECIFIC ADLs			
LoE	**Conclusion Statement**	**RCTs**	**References**
1b	**Neck vibration with prism adaptation** may produce greater improvements in neglect-specific ADLs than **neck vibration alone**.	1	Choi et al., 2022
1b	**Neck muscle taping** may not have a difference in efficacy compared to **sham taping** for improving neglect-specific ADLs.	1	Varalta et al., 2019

GENERAL ADLs			
LoE	Conclusion Statement	RCTs	References
2	**Visual exploration with neck muscle vibration** may produce greater improvements in general ADLs than **visual exploration alone**.	1	Schindler et al., 2002
1b	**Neck vibration with prism adaptation** may not have a difference in efficacy compared to **neck vibration alone** for improving general ADLs.	1	Choi et al., 2022

Key Points

Neck muscle vibration added to visual exploration may be beneficial for improving USN and general ADLs compared to visual exploration alone.

Neck muscle vibration added to prism adaptation may be beneficial for improving USN and neglect-specific ADLs compared to neck muscle vibration alone.

Neck muscle taping may not be beneficial for improving USN and neglect-specific ADLs compared to sham taping.

Transcutaneous Electrical Nerve Stimulation

Adapted from: https://flspinalsurgeon.com/transcutaneous-electrical-nerve-stimulation-tens/

Transcutaneous electrical nerve stimulation (TENS) involves the application of electrical current through surface electrodes on the skin to facilitate activation of nerves (Teoli et al., 2024). The application of afferent electrical stimulation at the sensory level may help to enhance neuroplasticity of the brain, through increased activation and recruitment of cortical networks involved in information processing of the contralesional hemifield. It is an alternative form of somatosensory stimulation, whereby the stimulation on the neglected side will also increase attention to the neglected side.

Four RCTs were found evaluating TENS interventions for neglect rehabilitation. Two RCTs compared TENS combined with visual scanning training to visual scanning training alone (Schroder et al., 2008; Senió w et al., 2016). One RCT compared different combinations of TENS with visuo-spatial cues and visual scanning training (Rusconi et al., 2002). One RCT examined the effect of electrical somatosensory stimulation combined with visual scanning training (Polanowska et al., 2009).

The methodological details and results of all 4 RCTs are presented in Table 10.

Table 10. RCTs evaluating transcutaneous electrical nerve stimulation interventions for neglect rehabilitation.

Authors (Year) Study Design (PEDro) Sample Size$_{start}$ Sample Size$_{end}$ Time post stroke	Interventions Duration: Session length, frequency per week for total number of weeks	Outcome Measures Result (direction of effect)
TENS combined with Visual Scanning Training		
Seniow et al. (2016) RCT (7) N_{Start}=29 N_{End}=29 TPS=Subacute	E: TENS + Visual Scanning Training C: Sham TENS + Visual Scanning Training Duration: 45min/d, 5d/wk for 3wks	• Behavioural Inattention Test (-)
Schroder et al. (2008) RCT (4) N_{Start}=30 N_{End}=30	E1: TENS + Computerized Scanning Training E2: Optokinetic Stimulation + Computerized Scanning Training C: Computerized Scanning Training	E2 vs C • Reading test A and Writing Tasks (+exp1, +exp2) • Behavioural Inattention Test (+exp1, +exp2)

TPS=Subacute	Duration: 25-40min/d, 5d/wk, for 4wks	E1 vs E2 • Reading test A, and Writing Tasks (-) • Behavioural Inattention Test (-)
Cueing/Feedback and TENS combined with Visual Scanning		
Rusconi et al. (2002) RCT (3) N_{Start}=20 N_{End}=20 TPS=Subacute	E1: Visual scanning training + verbal and visuo-spatial cues E2: Visual scanning training + verbal and visuo-spatial cues + TENS E3: Visual scanning training only (no feedback) + TENS E4: Visual scanning training only (no feedback) Duration: 1hr/d, 5d/wk for 8wks	E1/E2/E3 vs E4 • Line Cancellation Test (-) • Letter Cancellation Test (-) • Line Bisection Test (-) • Sentence Reading (-) • Facial Recognition (-) • Position Sense (-) • Clock Test (-) • Drawing of 2 Houses (-) • Raven's Coloured Matrices (-)
Electrical Somatosensory Stimulation combined with Visual Scanning		
Polanowska et al. (2009) RCT (8) N_{Start}=40 N_{End}=40 TPS=Subacute	E: Electrical Somatosensory Stimulation (using a device for TENS) + Computerized Visual Scanning Training C: Computerized Visual Scanning Training + Sham Stimulation Duration: 45min/d, 5d/wk for 4wks	• Line crossing test (+exp) • Star cancellation test (+exp) • Behavioural inattention test (+exp) • Single letter read aloud test (+exp) • Barthel Index (-)

Abbreviations and table notes: C=control group; D=days; E=experimental group; H=hours; Min=minutes; RCT=randomized controlled trial; TPS=time post stroke category (Acute: less than 30 days, Subacute: more than 1 month but less than 6 months, Chronic: over 6 months); Wk=weeks.
+exp indicates a statistically significant between groups difference at α=0.05 in favour of the experimental group
+exp_2 indicates a statistically significant between groups difference at α=0.05 in favour of the second experimental group
+con indicates a statistically significant between groups difference at α=0.05 in favour of the control group
- indicates no statistically significant between groups differences at α=0.05

Conclusions about transcutaneous electrical nerve stimulation

VISUOSPATIAL PROCESSING & USN			
LoE	**Conclusion Statement**	**RCTs**	**References**
1b	**TENS added to visual scanning training** may not have a difference in efficacy compared to **visual scanning training alone** for improving neglect.	2	Seniow et al., 2016; Schroder et al., 2008
2	**TENS either added to visual scanning training with feedback or without feedback** may not have a difference in efficacy compared to **visual scanning training alone** for improving neglect.	1	Rusconi et al., 2002
1b	**Electrical Somatosensory Stimulation combined with Visual Scanning Training** may produce greater improvements in neglect than **Visual Scanning Training** alone.	1	Polanowska et al., 2009

GENERAL ADLs			
LoE	**Conclusion Statement**	**RCTs**	**References**
1b	**Electrical Somatosensory Stimulation combined with Visual Scanning Training** may not have a difference in efficacy compared to **Visual Scanning Training** alone for improving general ADLs.	1	Polanowska et al., 2009

GLOBAL COGNITION			
LoE	**Conclusion Statement**	**RCTs**	**References**
2	**TENS either added to visual scanning training with feedback or without feedback** may not have a difference in efficacy compared to **visual scanning training alone** for improving global cognition.	1	Rusconi et al., 2002

Key Points

TENS added to visual scanning training may not be beneficial for improving neither USN nor global cognition compared to visual scanning training alone.

Electrical Somatosensory Stimulation combined with visual scanning training may be beneficial for improving USN compared to visual scanning training alone.

Repetitive Transcranial Magnetic Stimulation

Adapted from: https://www.technologynetworks.com/neuroscience/news/rtms-study-claims-to-improve-working-memory-319448

Transcranial magnetic stimulation is a painless and non-invasive method of affecting neural activity through the exogenous generation of an electromagnetic field through a coil placed on the scalp, that consequently induces a change in the electrical fields of the brain (Peterchev et al., 2012). The voltage and current of the electromagnetic field generated are dependent on the parameters of the stimulation device. The neuromodulatory effects of transcranial magnetic stimulation are attributed largely to neural membrane polarization shifts that can lead to changes in neuron activity, synaptic transmission, and activation of neural networks (Peterchev et al., 2012). Repetitive transcranial magnetic stimulation (rTMS) is the application of repetitive trains of transcranial magnetic stimulation at regular intervals.

After a stroke, interhemispheric competition is altered; with cortical excitability increasing in the unaffected hemisphere increasing and decreasing in the affected hemisphere (Zhang et al., 2017). rTMS can be used to help modulate this interhemispheric competition, with low stimulation frequencies (≤1Hz) decreasing cortical excitability and inhibiting activity of the contralesional hemisphere, while high frequency (>1Hz) stimulation increases excitability and have a facilitatory effect on activity of the ipsilesional hemisphere (Dionisio et al., 2018).

Nine RCTs were found evaluating rTMS interventions for neglect rehabilitation. Four RCTs compared low frequency rTMS to sham stimulation (Cha & Kim, 2015, 2016; Song et al., 2009; Yang et al., 2017). Two RCTs compared low frequency rTMS to high frequency rTMS, with one of them also compared these interventions to TBS (Kim et al., 2013; Yang et al., 2015). One RCT examined rTMS combined with visual scanning training (Iwański et al., 2020). One RCT examined rTMS combined with task-oriented training (Cha, 2017). One RCT compared different number of rTMS sessions to each other (Kim et al., 2015).

The methodological details and results of all 9 RCTs are presented in Table 11.

Table 11. RCTs evaluating repetitive transcranial magnetic stimulation interventions for neglect rehabilitation.

Authors (Year) Study Design (PEDro) Sample Size$_{start}$ Sample Size$_{end}$ Time post stroke	Interventions Duration: Session length, frequency per week for total number of weeks	Outcome Measures Result (direction of effect)
Low frequency rTMS vs. Conventional Rehabilitation or Sham Stimulation		
Yang et al. (2017) RCT (8) N_{Start}=60 N_{End}=56 TPS=Subacute	E1: rTMS (1 Hz) + Sensory Cueing E2: rTMS (1 Hz) C: Conventional Rehabilitation Duration: 1x/d for 2wks rTMS; 3hr/d & 5d/wk for 2wks wearing cueing device; 45min/d, 5d/wk for 2wks conventional rehabilitation	E1/E2 vs C • Behavioural Inattention Test (+exp1) ○ Cancellation (+exp1) ○ Drawing (-) • Catherine Bergego Scale (-) • Modified Barthel Index (-) E1 vs E2 • Behavioural Inattention Test (-) • Catherine Bergego Scale (-) • Modified Barthel Index (-)
Cha & Kim (2016) RCT (7) N_{Start}=30 N_{End}=30 TPS=Subacute	E: rTMS (1 Hz) + Conventional therapy C: Sham rTMS + Conventional therapy Duration: 20 min/d rTMS & 30min/d conventional therapy, 5d/wk for 4wks	• Line Bisection Test (+exp) • Albert Test (+exp)
Cha & Kim (2015) RCT (8) N_{Start}=22 N_{End}=20 TPS=Subacute	E: rTMS (1 Hz) + Conventional therapy C: Sham rTMS (1 Hz) + Conventional therapy Duration: 10min/d rTMS & 30min/d conventional therapy, 5d/wk for 4wks	• Motor Free Visual Perceptual Test (+exp) • Line Bisection Test (+exp) • Albert Test (+exp) • Star Cancellation Test (+exp)
Song et al. (2015) RCT (7) N_{Start}=14 N_{End}=14 TPS=Subacute	E: Low frequency rTMS + conventional rehabilitation C: Conventional rehabilitation Duration: 15min/session, 2x/d for 2wks	• Line Bisection (-) • Line Cancellation (+exp)
rTMS + Visual Scanning Training		
Iwanski et al. (2020) RCT (8) N_{Start}=28 N_{End}=27 TPS=Subacute	E: Low frequency rTMS + Visual scanning training + Conventional therapy C: Sham rTMS + Visual scanning training + Conventional therapy Duration: 30min/d, 5d/wk for 3wks rTMS + 45min/d visual scanning training + 75min/d conventional rehabilitation	• Behavioural Inattention Test - Conventional (-) • Star Cancellation (-) • Letter Cancellation (-) • Behavioural Inattention Test - Behavioural (-) • Functional Independence Measure and Functional Assessment Measure (-) • Visuospatial Scale (-)
rTMS + Task-oriented Training		
Cha 2017 RCT (10) N_{Start}=25 N_{End}=25 TPS=Subacute	E: Task-oriented training + rTMS (1Hz) C: Task-oriented training + Sham rTMS Duration: 30min/d task-oriented training + 20min/d rTMS, 5d/wk for 4wks	• Albert Test (+exp)
High Volume of rTMS vs. Low Volume of rTMS		
Kim et al. (2015) RCT (4) N_{Start}=34 N_{End}=34 TPS=Chronic	E: 10 sessions of daily rTMS + Conventional visuospatial rehabilitation C: A single session of rTMS+ Conventional visuospatial rehabilitation Duration: 20min/d, 5d/wk for 2wks or a single 20min session rTMS	• Letter Cancellation Test (+exp) • Line Bisection Test (+exp) • Ota's Task (+exp)
Low Frequency rTMS vs. High Frequency rTMS		

Yang et al. (2015) RCT (5) N_{Start}=38 N_{End}=38 TPS=Subacute	E1: Low frequency rTMS (1Hz) E2: High frequency rTMS (10Hz) E3: Continuous Theta Burst Stimulation (cTBS) C: Sham stimulation Duration: 30min/d for 2wks	E1/E2/E3 vs C • Star Cancellation Test (+exp1, +exp2, +exp3) • Line Bisection Test (+exp1, +exp2, +exp3) E2 vs E3/E1 • Star Cancellation Test (+exp3) • Line Bisection Test (+exp1, +exp3)
Kim et al. (2013) RCT (7) N_{Start}=27 N_{End}=27 TPS=Acute	E1: High frequency rTMS E2: Low frequency rTMS C: Sham Stimulation Duration: 20min/d, 5d/wk for 2wks	E1/E2 vs C • Line Bisection Test (+exp1) • Motor-Free Visual Perception Test (-) • Star Cancellation (-) • Catherine Bergego Scale (-) • Modified Barthel Index (+exp1, +exp2) E1 vs E2 • Line Bisection Test (-) • Motor-Free Visual Perception Test (-) • Star Cancellation (-) • Catherine Bergego Scale (-) • Modified Barthel Index (-)

Abbreviations and table notes: C=control group; D=days; E=experimental group; H=hours; Min=minutes; RCT=randomized controlled trial; TPS=time post stroke category (Acute: less than 30 days, Subacute: more than 1 month but less than 6 months, Chronic: over 6 months); Wk=weeks.
+exp indicates a statistically significant between groups difference at α=0.05 in favour of the experimental group
+exp_2 indicates a statistically significant between groups difference at α=0.05 in favour of the second experimental group
+con indicates a statistically significant between groups difference at α=0.05 in favour of the control group
- indicates no statistically significant between groups differences at α=0.05

Conclusions about repetitive transcranial magnetic stimulation

VISUOSPATIAL PROCESSING & USN			
LoE	**Conclusion Statement**	**RCTs**	**References**
1a	**Low frequency rTMS** may produce greater improvements in neglect than **sham rTMS/conventional care**.	5	Yang et al., 2017; Cha & Kim, 2016; Cha & Kim, 2015; Yang et al., 2015; Kim et al., 2013
1b	**High frequency rTMS** may produce greater improvements in neglect than **sham rTMS.**	2	Yang et al., 2015; Kim et al., 2013
1b	**rTMS with sensory cueing** may not have a difference in efficacy compared to **rTMS alone** for improving neglect.	1	Yang et al., 2017
1b	**rTMS with sensory cueing** may produce greater improvements in neglect than **conventional rehabilitation**.	1	Yang et al., 2017
1b	**rTMS with task-oriented training** may produce greater improvements in neglect than **sham rTMS with task-oriented training**.	1	Cha, 2017
1b	**High frequency rTMS** may not have a difference in efficacy compared to **low frequency rTMS** for improving neglect.	2	Yang et al., 2015 ; Kim et al., 2013
2	**A higher volume of rTMS therapy** (10 sessions) may produce greater improvements in neglect than **a lower volume of rTMS therapy (single session)**.	1	Kim et al., 2015
2	**rTMS** may not have a difference in efficacy compared to **continuous theta burst stimulation** for improving neglect.	1	Yang et al., 2015
1b	**rTMS with visual scanning training** may not have a difference in efficacy compared to **sham rTMS with visual scanning** for improving neglect.	1	Iwanski et al., 2020

NEGLECT- SPECIFIC ADLs			
LoE	**Conclusion Statement**	**RCTs**	**References**
1a	**Low frequency rTMS** may not have a difference in efficacy compared to **sham rTMS/conventional therapy** for improving neglect-specific ADLs.	2	Yang et al., 2017; Kim et al., 2013
1b	**High frequency rTMS** may not have a difference in efficacy as compared to **low frequency rTMS or sham rTMS** for improving neglect-specific ADLs.	1	Kim et al., 2013
1b	**rTMS with sensory cueing** may not have a difference in efficacy as compared to **conventional rehabilitation or rTMS alone** for improving neglect-specific ADLs.	1	Yang et al., 2017

GENERAL ADLs			
LoE	**Conclusion Statement**	**RCTs**	**References**
1a	The evidence is mixed for the efficacy of **low frequency rTMS** compared to **sham rTMS/conventional therapy** for improving general ADLs.	2	Yang et al., 2017; Kim et al., 2013
1b	**High frequency rTMS** may not have a difference in efficacy compared to **low frequency rTMS** for improving general ADLs.	1	Kim et al., 2013
1b	**rTMS with visual scanning** may not have a difference in efficacy compared to **sham rTMS with visual scanning** for improving general ADLs.	1	Iwanski et al., 2020
1b	**rTMS with sensory cueing** may not have a difference in efficacy compared to **rTMS alone/ conventional rehabilitation** for improving general ADLs.	1	Yang et al., 2017

Key Points

Low-frequency rTMS and high-frequency rTMS may be beneficial for improving USN, but not general ADLs, when compared to sham rTMS/conventional rehabilitation.

High frequency and low frequency rTMS may not have any difference with each other for improving USN.

Theta Burst Stimulation

Adapted from: https://www.psychiatryadvisor.com/home/depression-advisor/intermittent-theta-burst-stimulation-for-major-depressive-disorder-treatment/

Theta Burst Stimulation (TBS) is an emerging treatment modality that is a patterned form of rTMS where stimulation pulses are delivered in triplets or bursts at a high frequency (50Hz), and in a short interval (200ms), intending to mimic naturally occurring theta brain oscillations (Schwippel et al., 2019). TBS can also be used to adjust interhemispheric rivalry after a stroke through the delivery of continuous TBS (cTBS) to reduce cortical excitability in the contralesional hemisphere (600 pulses over 40 seconds); or intermittent TBS (iTBS) to increase cortical excitability in the ipsilesional hemisphere (600 pulses over 190 seconds) (Cotoi et al., 2019; Schwippel et al., 2019).

Nine RCTs were found evaluating TBS interventions for neglect rehabilitation. Five RCTs compared TBS to sham stimulation (Cazzoli et al., 2012; Cazzoli et al., 2015; Fu et al., 2015; Koch et al., 2012; Nyffeler et al., 2019). Two RCTs compared TBS at 80% of resting motor threshold to TBS at 40% resting motor threshold (Cao et al., 2016; Fu et al., 2017). One RCT examined TBS combined with prism adaptation (Vatanparasti et al., 2019). One RCT compared continuous TBS to high and low frequency rTMS (Yang et al., 2015).

The methodological details and results of all 9 RCTs are presented in Table 12.

Table 12. RCTs evaluating theta burst stimulation interventions for neglect rehabilitation.

Authors (Year) Study Design (PEDro) Sample Size$_{start}$ Sample Size$_{end}$ Time post stroke	**Interventions Duration: Session length, frequency per week for total number of weeks**	**Outcome Measures Result (direction of effect)**
Theta Burst Stimulation vs Sham		
Nyffeler et al. (2019) RCT (7) N_{Start}=30 N_{End}=30 TPS=Acute	E1: 8 Trains of Continuous TBS E2: 16 Trains of Continuous TBS C: Sham Continuous TBS Duration: 44 sec/ Continuous TBS, 4 Continuous TBS trains/d, 2d in E1, 4d in E2	E1/E2 vs C • Composite Score (Fluff Test, Two-Part Picture Test, Bird Cancellation Task) (+exp1, +exp2) • Functional Independence Measure (+exp1, +exp2) • Lucerne ICF-based Multidisciplinary Observation Scale (LIMOS) (+exp1, +exp2)

		• Catherine Bergego Scale (+exp1, +exp2) E1vs E2 • Catherine Bergego Scale (-) • Composite Score (Fluff Test, Two-Part Picture Test, Bird Cancellation Task) (-) • Functional Independence Measure (-)
Cazzoli et al. (2015) RCT (4) N_{Start}=10 N_{End}=10 TPS=Acute Note: 3 subjects participated in both conditions are not included	E: Continuous TBS C: Sham Continuous TBS Duration: NR	• Computer Balloon Search Test (+exp) • Star Cancellation (+exp) • Random Shape Cancellation Test (+exp)
Fu et al. (2015) RCT (7) N_{Start}=22 N_{End}=20 TPS=Subacute	E: cTBS + Conventional rehabilitation C: Sham cTBS + Conventional rehabilitation Duration: 60min/d for 2wks cTBS & 30min 2x/d for 2wks rehabilitation	• Star Cancellation Test (+exp) • Line Bisection Test (-)
Cazzoli et al. (2012) Cross-over RCT (9) N_{Start}=24 N_{End}=24 TPS=Acute	E1: cTBS (1min) then sham TBS E2: sham TBS then cTBS C: No stimulation Duration: 90min/treatment,1d washout	E1/E2 vs C • Catherine Bergego Scale (+exp1, exp2) • Vienna Test System – Peripheral Perception (+exp1, exp2) • Random Shape Cancellation Test (+exp1, exp2) • Two Part Picture Scanning Test (+exp1, exp2) • Munich Reading Texts (-)
Koch et al. (2012) RCT (8) N_{Start}=20 N_{End}=18 TPS=Not reported	E: Continuous TBS + Conventional Therapy C: Sham cTBS + Conventional Therapy Duration: 15min/session, 2x/d, 5d/wk for 2wks	• Behavioural Inattention Test-behavioural (+exp) • Behavioral Inattention Test-conventional (+exp)
Theta Bursts at 80% vs. 40% Resting Motor Threshold		
Fu et al. (2017) RCT (7) N_{Start}=12 N_{End}=12 TPS=Subacute	E: cTBS (80% Resting Motor Threshold) + standard visual scanning training + movement function training C: cTBS (40% Resting Motor Threshold) + standard visual scanning training + movement function training Duration: 40sec/session, 4x/d for 10d (consecutive)	• Line Bisection Test (+exp) • Star Cancelation Test (+exp)
Cao et al. (2016) RCT (3) N_{Start}=13 N_{End}=13 TPS=Subacute	E: 80% Resting Motor Threshold Intermittent TBS C: 40% Resting Motor Threshold Intermittent TBS Duration: 15min/session, 2x/d for 10d	• Line Bisection Task (+exp) • Star Cancellation Test (+exp)
Theta Bursts stimulation added to prism adaptation		
Vatanparasti et al. (2019) RCT (6) N_{Start}=15 M_{End}=14 TPS=Chronic	E: Prism Adaptation (PA) + Continuous TBS C: PA + Sham cTBS Duration: 20min/d, 5d/wk for 2wks	• Star Cancellation Test (-) • Line Bisection Test (-) • Number of Lines on the Left Side (-) • Figure Copying Test (-) • Clock Drawing (-) • Modified Rankin Scale (-)
Low Frequency TBS vs. High Frequency TBS		
Yang et al. (2015) RCT (5) N_{Start}=38 N_{End}=38 TPS=Subacute	E1: Low frequency rTMS (1Hz) E2: High frequency rTMS (10Hz) E3: Continuous TBS C: Sham TBS Duration: 30min/d, 2wks	E1/E2/E3 vs C • Star Cancellation Test (+exp1, +exp2, +exp3) • Line Bisection Test (+exp1, +exp2 +exp3) E2 vs E3/E1 • Star Cancellation Test (+exp3)

		• Line Bisection Test (+exp1, +exp3)

Abbreviations and table notes: C=control group; D=days; E=experimental group; H=hours; Min=minutes; RCT=randomized controlled trial; TPS=time post stroke category (Acute: less than 30 days, Subacute: more than 1 month but less than 6 months, Chronic: over 6 months); Wk=weeks.
+exp indicates a statistically significant between groups difference at α=0.05 in favour of the experimental group
+exp_2 indicates a statistically significant between groups difference at α=0.05 in favour of the second experimental group
+con indicates a statistically significant between groups difference at α=0.05 in favour of the control group
- indicates no statistically significant between groups differences at α=0.05

Conclusions about theta burst stimulation

VISUOSPATIAL PROCESSING & USN			
LoE	**Conclusion Statement**	**RCTs**	**References**
1a	**TBS** may produce greater improvements in neglect than **sham stimulation**.	6	Nyffeler et al, 2019; Cazzoli et al., 2015; Fu et al., 2015; Yang et al., 2015; Cazzoli et al., 2012; Koch et al., 2012
1b	**TBS at 80% of resting motor threshold** may produce greater improvements in neglect than **TBS at 40% resting motor threshold**.	2	Fu et al., 2017; Cao et al., 2016
2	**Continuous TBS** may produce greater improvements in neglect than **high frequency rTMS**.	1	Yang et al., 2015
1b	**Eight Trains of continuous TBS** may not have a difference in efficacy compared to **sixteen trains of continuous TBS** for improving neglect.	1	Nyffeler et al, 2019
1b	**cTBS with prism adaptation** may not have a difference in efficacy compared to **sham cTBS with prism adaptation** for improving neglect.	1	Vatanparasti et al., 2019

NEGLECT- SPECIFIC ADLs			
LoE	**Conclusion Statement**	**RCTs**	**References**
1a	**TBS** may produce greater improvements in neglect-specific ADLs than **sham stimulation**.	2	Nyffeler et al, 2019 ; Cazzoli et al., 2012
1b	**Eight trains of continuous TBS** may not have a difference in efficacy compared to **sixteen trains of continuous TBS** for improving neglect-specific ADLs.	1	Nyffeler et al., 2019

GENERAL ADLs			
LoE	**Conclusion Statement**	**RCTs**	**References**
1b	**TBS** may produce greater improvements in general ADLs than **sham stimulation**.	1	Nyffeler et al., 2019
1b	**Eight Trains of continuous TBS** may not have a difference in efficacy compared to **sixteen trains of continuous TBS** for improving general ADLs.	1	Nyffeler et al., 2019

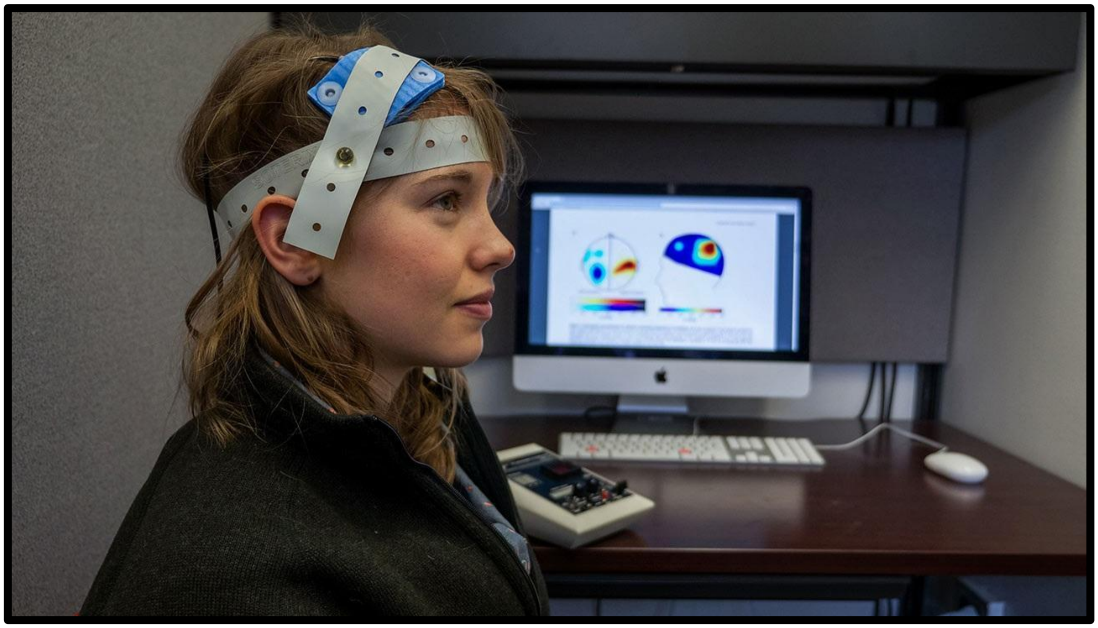
1b	**cTBS with prism adaptation** may not have a difference in efficacy compared to **sham cTBS with prism adaptation** for improving general ADLs.	1	Vatanparasti et al., 2019

Key Points

Continuous TBS may be beneficial for improving USN, neglect-specific ADLs, and general ADLs when compared to sham stimulation.

Continuous TBS added to prism adaptation may not be beneficial for improving USN or general ADLs when compared to prism adaptation alone.

Transcranial Direct Current Stimulation



Adapted from: https://www.sciencemag.org/news/2016/02/brain-zapping-therapies-might-be-hitting-lefties-wrong-side-head

Another form of non-invasive brain stimulation is transcranial direct current stimulation (tDCS). This procedure involves the application of mild electrical currents (1-2 mA) conducted through two saline-soaked, surface electrodes applied to the scalp, overlaying the area of interest and the contralateral forehead above the orbit. Anodal stimulation is performed over the affected hemisphere and increases cortical excitability, while cathodal stimulation is performed over the unaffected hemisphere and decreases cortical excitability (Alonso-Alonso & Pascual-Leone, 2007). Additionally, tDCS can be applied on both hemispheres concurrently, this is known as dual tDCS. In contrast to transcranial magnetic stimulation, tDCS does not induce action potentials, but instead modulates the resting membrane potential of the neurons (Alonso-Alonso & Pascual-Leone, 2007).

Seven RCTs were found evaluating tDCS interventions for neglect rehabilitation. Three RCTs compared different modalities of tDCS (Dual, Cathodal, Anodal) to sham tDCS (da Silva et al., 2022; Ko et al., 2008; Sunwoo et al., 2013). One RCT evaluated the combination of tDCS modalities and prism adaptation (Làdavas et al., 2015). One RCT compared anodal multi-site vs single site tDCS in combination with cognitive neglect training (Zhao et al., 2023). One RCT examined dual tDCS combined with feedback training compared to feedback training alone (Bang & Bong, 2015). One RCT examined the combination of Transorbital Alternating Current Stimulation (tACS) combined with a visual scanning task (Middag-van Spanje et al., 2024).

The methodological details and results of the 7 RCTs are presented in Table 13.

Table 13. RCTs evaluating transcranial direct current stimulation interventions for neglect rehabilitation.

Authors (Year) Study Design (PEDro) Sample Size$_{start}$ Sample Size$_{end}$ Time post stroke	Interventions Duration: Session length, frequency per week for total number of weeks	Outcome Measures Result (direction of effect)

Anodal Transcranial Direct Current Stimulation vs. Sham		
Da Silva et al. (2022) RCT (7) N_{Start}=51 N_{End}=46 TPS=Subacute	E1: Anodal tDCS + Physical therapy E2: Cathodal tDCS + Physical therapy C: Sham tDCS + Physical therapy Duration: 20min/d, 2d/wk for 7.5wks + 1hr/d physical therapy	<u>E1/E2 v C</u> • Behavioural Inattention Test-conventional (+exp1) • Catherine Bergego Scale (-) • Barthel Index (-) • Modified Rankin Scale (-) • Functional Independence Measure (-) • EuroQol-5-D Questionnaire (-) <u>E1 v E2</u> • Behavioural Inattention Test-conventional (-) • Catherine Bergego Scale (-) • Barthel Index (-) • Modified Rankin Scale (-) • Functional Independence Measure (-) • EuroQol-5-D Questionnaire (-)
Sunwoo et al. (2013) RCT (6) N_{Start}=10 N_{End}=10 TPS=Chronic	E1: Dual tDCS E2: Anodal tDCS C: Sham tDCS Duration: 20min/session, 24h washout	<u>E1/E2 vs C</u> • Line Bisection Test (+exp1, +exp2) • Star Cancellation Test (-) <u>E1 vs E2</u> • Line Bisection Test (+exp1) • Star Cancellation Test (-)
Ko et al. (2008) Cross-over RCT (8) N_{Start}=15 N_{End}=15 TPS=Subacute	E: Active Anodal tDCS C: Sham Stimulation Duration: 20min, 1 session each	• Figure Cancellation (+exp) • Line Bisection Test (+exp)
Transcranial Direct Current Stimulation + Prism Adaptation		
Ladavas et al. (2015) RCT (8) N_{Start}=30 N_{End}=30 TPS=Subacute	E1: Cathodal tDCS + Prism Adaptation E2: Anodal tDCS + Prism Adaptation C: Sham tDCS+ Prism Adaptation Duration: 20min/d tDCS + 30min/session Prism Adaptation, 5d/wk, 2wks	<u>E1 vs C</u> • Behavioural Inattention Test (+con) <u>E2 vs C</u> • Behavioural Inattention Test (+exp2) <u>E1 vs E2</u> • Behavioural Inattention Test (+exp2)
Transcranial Direct Current Stimulation + Cognitive Neglect Training		
Zhao et al. (2023) RCT (5) N_{Start}=30 N_{End}=30 TPS=Subacute	E1: Anodal Multi-site tDCS + Cognitive Neglect Training E2: Anodal Single site tDCS + Cognitive Neglect Training C: Sham tDCS + Cognitive Neglect Training Duration: 20min/d, 5d/wk for 3wks	<u>E1/E2 v C</u> • Behavioral Inattention Test (+exp1, +exp2) • Deviation Index (+exp1, +exp2) • Line Crossing Test (+exp1, +exp2) • Star Cancellation Test (+exp1, +exp2) • Letter Cancellation Test (+exp1, +exp2) • Line Bisection Test (+exp1, +exp2) • Figure and Shape Copying (-) • Representational Drawing (-) <u>E1 v E2</u> • Behavioral Inattention Test (-) • Deviation Index (-) • Line Crossing Test (-) • Star Cancellation Test (-) • Letter Cancellation Test (-) • Line Bisection Test (-) • Figure and Shape Copying (-) • Representational Drawing (-)
Dual Transcranial Direct Current Stimulation + Feedback Training		
Bang et al. (2015) RCT (6) N_{Start}=12	E: Dual tDCS + Feedback training C: Feedback training Duration: 50min/d,5d/wk,3wks	• Motor-Free Visual Perception Test (+exp) • Line bisection test (+exp) • Modified Barthel Index (+exp)

N_{End}=12 TPS=Subacute Feasibility/pilot RCT		
Transorbital Alternating Current Stimulation + Visual Scanning Task		
Middag-van Spanje et al. (2024) RCT (9) N_{Start}=22 N_{End}=19 TPS=Chronic	E: Transcranial alternating current stimulation (tACS) + Visual Scanning Training (VST) C: Sham tACS + VST Duration: 40min, 3x/wk for 6wk	• Star Cancellation Task (+exp) • Computerized Visual Detection Task (+exp) • McIntosh Line Bisection Task - digitized (MLBT-d) (-) • Schenkenberg Line Bisection Task (-) • Baking Tray Task (-) • Catherine Bergego Scale (-) • Subjective Neglect Questionnaire (-)

Abbreviations and table notes: C=control group; D=days; E=experimental group; H=hours; Min=minutes; RCT=randomized controlled trial; TPS=time post stroke category (Acute: less than 30 days, Subacute: more than 1 month but less than 6 months, Chronic: over 6 months); Wk=weeks.
+exp indicates a statistically significant between groups difference at α=0.05 in favour of the experimental group
+exp_2 indicates a statistically significant between groups difference at α=0.05 in favour of the second experimental group
+con indicates a statistically significant between groups difference at α=0.05 in favour of the control group
- indicates no statistically significant between groups differences at α=0.05

Conclusions about transcranial direct current stimulation

VISUOSPATIAL PROCESSING & USN			
LoE	**Conclusion Statement**	**RCTs**	**References**
1a	**Anodal tDCS** may produce greater improvements in neglect than **Sham Stimulation**.	2	Sunwoo et al., 2013; Ko et al., 2008
1b	There is conflicting evidence regarding the effectiveness of **Dual tDCS**, compared to **Sham Stimulation or Anodal tDCS** for the improvement of neglect.	1	Sunwoo et al., 2013
1b	**Cathodal tDCS** combined with **Prism Adaptation** may not be effective for neglect, compared to **Sham Stimulation** in combination to **Prism Adaptation**.	1	Ladavas et al., 2015
1b	**Anodal tDCS** combined with **Prism Adaptation** may lead to improvements in neglect compared to **Sham Stimulation or Cathodal tDCS** in combination with **Prism Adaptation**.	1	Ladavas et al., 2015
2	**Anodal Multisite tDCS** combined with **Cognitive Neglect Training** may be more effective for the improvement of neglect compared to **Sham Stimulation** in combination with **Cognitive Neglect Training.**	1	Zhao et al., 2023
2	**Anodal Single Site tDCS** combined with **Cognitive Neglect Training** may be more effective for the improvement of neglect compared to **Sham Stimulation** in combination with **Cognitive Neglect Training.**	1	Zhao et al., 2023
2	**Anodal Multisite tDCS** combined with **Cognitive Neglect Training** may not be more effective than **Anodal Single Site tDCS** in combination with **Cognitive Neglect Training** for the improvement of neglect.	1	Zhao et al., 2023
1b	**Anodal tDCS** combined with **Physical Therapy** may be more effective for the improvement of neglect than	1	Da Silva et al., 2022

	Sham Stimulation combined with **Physical Therapy**.		
1b	**Cathodal tDCS** combined with **Physical Therapy** may not be more effective for the improvement of neglect than **Sham Stimulation** combined with **Physical Therapy**.	1	Da Silva et al., 2022
1b	**Anodal tDCS** combined with **Physical Therapy** may not be more effective than **Cathodal tDCS** combined with **Physical Therapy**.	1	Da Silva et al., 2022
1b	**Dual tDCS** in combination with **Feedback Training** may be more effective for the improvement of neglect than **Feedback Training** alone.	1	Bang et al., 2015
1b	There is conflicting evidence regarding the use of **Transorbital Alternating Current Stimulation** in combination with **Visual Scanning Task** for the improvement of neglect, compared to **Sham Stimulation** in addition to **Visual Scanning Task.**	1	Middag-van Spanje 2024

NEGLECT- SPECIFIC ADLs			
LoE	**Conclusion Statement**	**RCTs**	**References**
1b	**Anodal tDCS** combined with **Physical Therapy** may not be more effective for the improvement of neglect-specific ADLs, compared to **Sham Stimulation** combined with **Physical Therapy**.	1	Da Silva et al., 2022
1b	**Cathodal tDCS** combined with **Physical Therapy** may not be effective for the improvement of neglect-specific ADLs, compared to **Sham Stimulation** combined with **Physical Therapy**.	1	Da Silva et al., 2022
1b	**Cathodal tDCS** combined with **Physical Therapy** may not be more effective for the improvement of neglect-specific ADLs than **Anodal tDCS** combined with **Physical Therapy**.	1	Da Silva et al., 2022
1b	**Transorbital Alternating Current Stimulation** in combination with **Visual Scanning Task** may not be effective for neglect-specific ADLs, compared to **Sham Stimulation** in addition to **Visual Scanning Task.**	1	Middag-van Spanje 2024

GENERAL ADLs			
LoE	**Conclusion Statement**	**RCTs**	**References**
1b	**Anodal tDCS** combined with **Physical Therapy** may not be more effective for the improvement of general ADLs, compared to **Sham Stimulation** combined with **Physical Therapy**.	1	Da Silva et al., 2022
1b	**Cathodal tDCS** combined with **Physical Therapy** may not be effective for the improvement of neglect-specific ADLs, compared to **Sham Stimulation** combined with **Physical Therapy**.	1	Da Silva et al., 2022

1b	**Cathodal tDCS** combined with **Physical Therapy** may not be more than **Anodal tDCS** combined with **Physical Therapy** for the improvement of general ADLs.	1	Da Silva et al., 2022
1b	**Dual tDCS** in combination with **Feedback Training** may be more effective for the improvement of general ADLs than **Feedback Training** alone.	1	Bang et al., 2015

Key Points

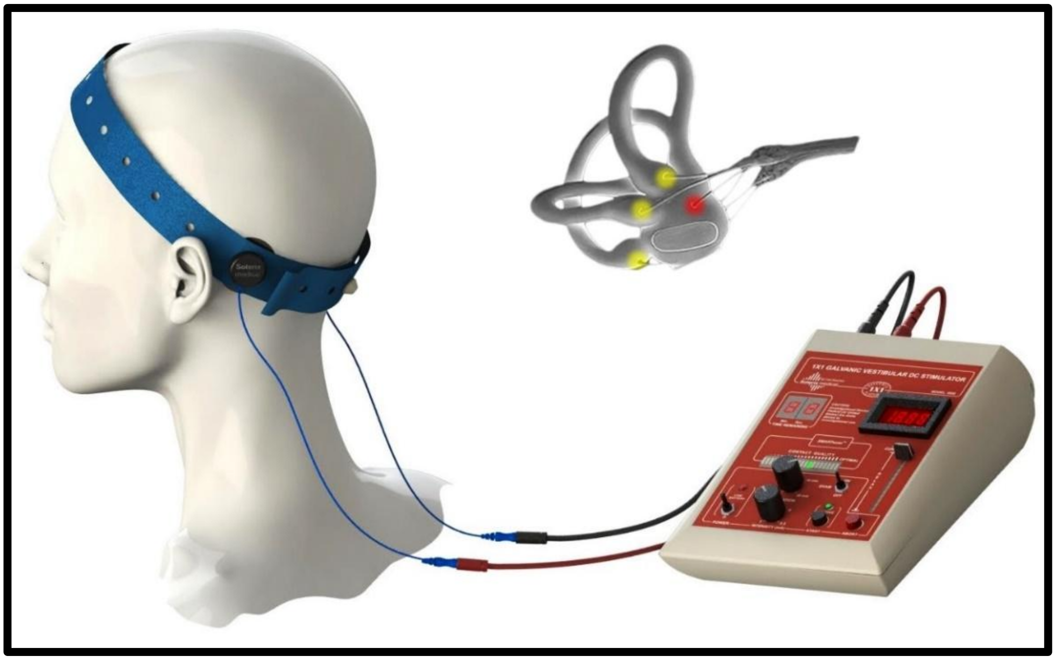
Anodal tDCS either alone or as an adjunct therapy may be beneficial for improving USN, but not neglect-specific or general ADLs, compared to sham stimulation.

Cathodal tDCS may not be beneficial for improving USN, neglect-specific or general ADLs, compared to sham stimulation.

Dual tDCS added to feedback training may be beneficial for improving USN or general ADLs, compared to feedback training alone.

The literature is limited and mixed regarding the effect of dual tACS for improving USN.

Vestibular Stimulation



Adapted from: https://baystateherald.com/2019/08/26/global-neuro-stimulation-equipment-market-insights-global-analysis-and-forecast-by-2025-by-ndi-medical-llc-boston-scientific-corporation-neuronetics-medtronic/

Vestibular stimulation is a variant of tDCS. It is a non-invasive neuromodulation technique that involves placing electrodes directly over the vestibular nerve (which is responsible for the patient's sense of balance) and sending electrical signals through the skull (Krewer et al., 2013). Spatial perception and exploration is a multisensory task requiring the integration of signals from visual, auditory, proprioceptive and vestibular cortices (Barra et al., 2010). If neglect is assumed to be an error in the perceptual integration and transformation of this information, manipulating input (vestibular) could ameliorate the impact of neglect.

Six RCTs evaluated vestibular stimulation interventions for neglect rehabilitation. Four RCTs compared galvanic vestibular stimulation (GVS) to sham stimulation (Ruet et al., 2014; Schmidt et al., 2013; K. S. Utz et al., 2011; Volkening et al., 2018). One RCT compared high and low intensity GVS to sham stimulation (Wilkinson et al., 2014). One RCT compared manual vestibular rehabilitation to conventional rehabilitation (Dai et al., 2013).

The methodological details and results of all six RCTs are presented in Table 14.

Table 14. RCTs evaluating of vestibular stimulation interventions for neglect rehabilitation.

Authors (Year) Study Design (PEDro) Sample Size$_{start}$ Sample Size$_{end}$ Time post stroke	Interventions Duration: Session length, frequency per week for total number of weeks	Outcome Measures Result (direction of effect)
Galvanic Vestibular Stimulation vs Sham		
Ruet et al. (2014) Cross-over RCT (4) N$_{Start}$=4 N$_{End}$=4 TPS=Subacute	E1: Left Cathodal GVS E2: Cathode-right, anode-left GVS C: Sham GVS Duration: 20min sessions, 48hr washout	E1/E2 v C • Line Bisection Task (-) • Star Cancellation Test (-)

Schmidt et al. (2013) Cross-over RCT (7) N_{Start}=7 N_{End}=7 TPS=Chronic	E1: Right Cathodal GVS E2: Left Cathodal GVS C: Sham GVS Duration: 20min sessions, 48hr washout	E1 vs E2 • Arm Position Sense - Left Arm: (-) E1/E2 vs C • Arm Position Sense - Left Arm: (+exp2)
Utz et al. (2011) Cross-over RCT (7) N_{Start}=6 N_{End}=6 TPS=Subacute	E1: Right Cathodal GVS E2: Left Cathodal GVS C: Sham GVS Duration: 20min sessions, 24hr washout	E1/E2 vs C • Line Bisection Test (+exp1) E1 vs E2 • Line Bisection Test (-)
Galvanic Vestibular Stimulation + Conventional Neglect Treatment		
Volkening et al. (2018) RCT (7) N_{Start}=29 N_{End}=24 TPS=Subacute	E1: Left GVS + Conventional Neglect Treatment E2: Right Cathodal GVS + Conventional Neglect Treatment C: Sham Stimulation + Conventional Neglect Treatment Duration: 20min/d, 5d/wk, total 10-12 sessions	E1/E2 vs C • Behavioural Inattention Test (-) ○ Line Cancellation (-) ○ Letter Cancellation (-) ○ Line Bisection (-) ○ Star Cancellation (-) ○ Star Copying (-) ○ Diamond Copying (-) ○ Flower Copying (-) ○ Address Copying (-) • Visuo-tactile Search Task (-) • Subjective visual and haptic vertical (-) E1 vs E2 • Behavioural Inattention Test (-) ○ Line Cancellation (-) ○ Letter Cancellation (-) ○ Line Bisection (-) ○ Star Cancellation (-) ○ Star Copying (-) ○ Diamond Copying (-) ○ Flower Copying (-) ○ Address Copying (-) • Visuo-tactile Search Task (-) • Subjective visual and haptic vertical (-)
High Intensity GVS vs. Low Intensity GVS		
Wilkinson et al. (2014) RCT (8) N_{Start}=52 N_{End}=49 TPS=Subacute	E1: 10 Active Sessions + 0 Sham Sessions GVS E2: 5 Active Sessions + 5 Sham GVS C: 1 Active Session + 9 Sham GVS Duration: 25min/d, 5d/wk, for 2wk	E1/E2 vs C • Behavioural Inattention Test (-) • Barthel Index (-)
Manual Vestibular Rehabilitation vs. Conventional Rehabilitation		
Dai et al. (2013) RCT (5) N_{Start}=55 N_{End}=48 TPS=Subacute	E: Vestibular Rehabilitation + Conventional Rehabilitation C: Conventional Rehabilitation Duration: 30min/d, 4wks & 2h/d, 5d/wk Conventional Rehabilitation	• Behavioral Inattention Test (-) • Functional Independence Measure Score (-)

Abbreviations and table notes: C=control group; D=days; E=experimental group; H=hours; Min=minutes; RCT=randomized controlled trial; TPS=time post stroke category (Acute: less than 30 days, Subacute: more than 1 month but less than 6 months, Chronic: over 6 months); Wk=weeks.
+exp indicates a statistically significant between groups difference at α=0.05 in favour of the experimental group
+exp2 indicates a statistically significant between groups difference at α=0.05 in favour of the second experimental group
+con indicates a statistically significant between groups difference at α=0.05 in favour of the control group
- indicates no statistically significant between groups differences at α=0.05

Conclusions about Vestibular stimulation

VISUOSPATIAL PROCESSING & USN			
LoE	**Conclusion Statement**	**RCTs**	**References**

1b	**Left or Right Cathodal Galvanic Vestibular** combined with **Conventional Neglect Therapy** may not be effective for improving neglect compared to **Sham Stimulation** in combination with **Conventional Neglect Therapy.**	1	Volkening et al., 2018
1b	**Left Cathodal Galvanic Vestibular Stimulation** combined with **Conventional Neglect Therapy** may not be more effective than **Right Cathodal Galvanic Vestibular Stimulation** in combination with **Conventional Neglect Therapy** for the treatment of neglect.	1	Volkening et al., 2018
1a	**Left or Right Cathodal Galvanic Vestibular Stimulation** compared to **Sham Stimulation** may not be effective for the improvement of neglect.	3	Ruet et al., 2014 Schimidt et al., 2013 Utz et al., 2011
1a	**Left Cathodal Galvanic Vestibular Stimulation** may not be more effective than **Right Cathodal Galvanic Vestibular Stimulation** for the improvement of neglect.	3	Ruet et al., 2014 Schimidt et al., 2013 Utz et al., 2011
1b	**High or Low Intensity Galvanic Vestibular Stimulation** may not have a difference in efficacy compared to **Sham Stimulation** for improving neglect.	1	Wilkinson et al., 2014
2	**Vestibular Rehabilitation** may not have a difference in efficacy compared to **Conventional rehabilitation** for improving neglect.	1	Dai et al., 2013

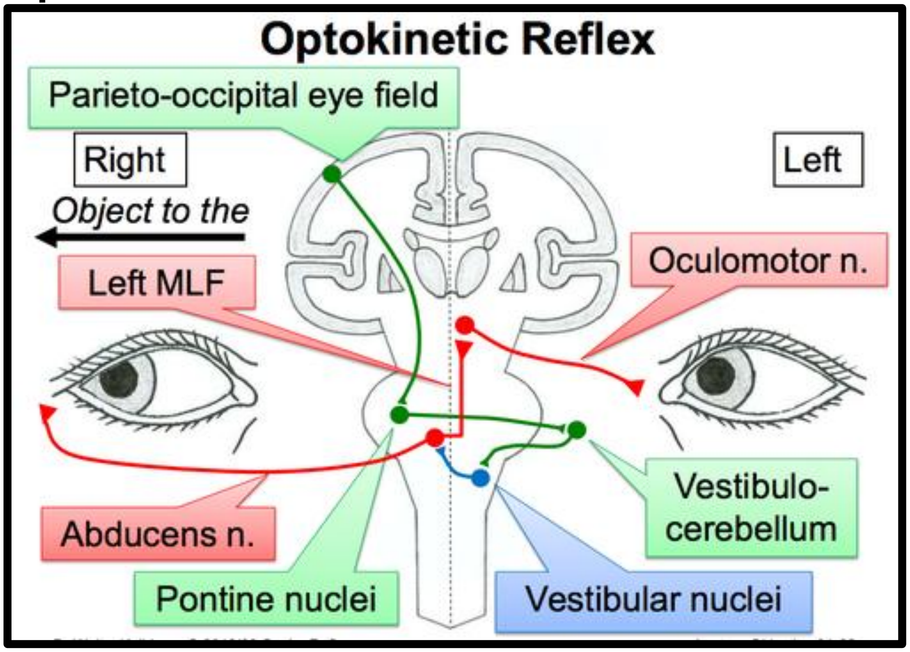
GENERAL ADLs			
LoE	**Conclusion Statement**	**RCTs**	**References**
1b	**High or Low Intensity Galvanic Vestibular Stimulation** may not have a difference in efficacy compared to **Sham Stimulation** for improving general ADLs.	1	Wilkinson et al., 2014
2	**Vestibular Rehabilitation** may not have a difference in efficacy compared to **Conventional rehabilitation** for improving general ADLs.	1	Dai et al., 2013

Key Points

Right- or left-sided, high- or low-intensity GVS may not be beneficial for improving USN or general ADLs compared to sham stimulation.

Vestibular rehabilitation may not be beneficial for improving USN or general ADLs compared to conventional rehabilitation.

Optokinetic Stimulation



Adapted from: https://www.cram.com/flashcards/neuroanatomy-lecture-31-ocular-reflexes-1481121

Optokinetic stimulation (OKS) uses a visual stimulus moving linearly from right to left to induce the optokinetic reflex and nystagmus in the contralesional direction (Pierce & Buxbaum, 2002). By inducing the slow phase of nystagmus, a patient is 'forced' to spend more time focusing in the neglected hemifield. Like vestibular stimulation, optokinetic stimulation is also believed to function by modulating sensory input to the representation of personal space, and egocentric reference frames (Karnath, 1996).

Six RCTs were found evaluating optokinetic stimulation interventions for neglect rehabilitation. Two RCTs examined the effect of optokinetic stimulation combined with eye patching (Machner et al., 2014; Wang et al., 2015). Two RCTs examined the effect of optokinetic stimulation combined with visual scanning training (Kerkhoff et al., 2012; Schroder et al., 2008). One RCT compared optokinetic stimulation to standard neglect rehabilitation (Pizzamiglio et al., 2004). One RCT compared optokinetic stimulation combined with Cued-reading training vs General neuropsychological treatment (genannt Bode et al., 2023).

The methodological details and results of all 6 RCTs are presented in Table 15.

Table 15. RCTs evaluating optokinetic stimulation interventions for neglect rehabilitation.

Authors (Year) Study Design (PEDro) Sample Size$_{start}$ Sample Size$_{end}$ Time post stroke	Interventions Duration: Session length, frequency per week for total number of weeks	Outcome Measures Result (direction of effect)
Optokinetic Stimulation with Eye Patch vs. Usual Care		

Wang et al. (2015)
RCT (4)
N_{Start}=9
N_{End}=9
TPS=Acute
	E: Optokinetic Stimulation Training with eye patching + Conventional Treatment
	C: Conventional Treatment
	Duration: 20min/d, 4wks stimulation + 6hr/d, 4wks patching
		• Behavioural Inattention Test (+exp)
		  ○ Conventional (+exp)
		  ○ Behavioural (+exp)
		• Equilibrium Coordination Test (-)
		• Nonequilibrium Coordination Test (+exp)

Machner et al. (2014) RCT (6) N_{Start}=23 N_{End}=21 TPS=Acute	E: Hemifield Eye Patching and Repetitive Optokinetic Stimulation (15min/d) + Usual Care C: Usual Care Duration: 7d	• Catherine Bergego Scale (-) • Bell's Cancellations Test (-) • Star Cancellation Test (-) • Line Bisection Test (-) • Ogden Figure Copying Task (-) • Reading Errors (-)
Optokinetic Stimulation vs. Standard Neglect Rehabilitation		
Pizzamiglio et al. (2004) RCT (2) N_{Start}=22 N_{End}=22 TPS=Sub acute	E: Optokinetic Stimulation + Standard Neglect Rehabilitation C: Standard Neglect Rehabilitation Duration: 1hr/d, 5d/wk, for 6wks	• Line Cancellation (-) • Letter Cancellation (-) • Wundt-Jastrow Illusion (-) • Reading (-) • Comb and Razor (-) • Semi-structured Scale for the Functional Evaluation of Hemi-Inattention (-) • Line Bisection Test (-)
Optokinetic Stimulation vs. Visual Scanning Training or Sham		
Kerkhoff et al. (2012) RCT (6) N_{Start}=20 N_{End}=20 TPS=Subacute	E: Optokinetic Stimulation + visual scanning training C: Visual Scanning Duration: 50min/d, 5d/wk for 4wk	• Auditory Subjective Median Plane - Mean Deviation (+exp)
Schroder et al. (2008) RCT (6) N_{Start}=30 N_{End}=30 TPS=Subacute	E1: TENS + Computerized Scanning Training E2: Optokinetic Stimulation + Computerized Scanning Training C: Computerized Scanning Training Duration: 20-40min/d, 5d/wk for 4wk	E1/E2 vs C • Reading test A and Writing Tasks (+exp1, +exp2) • Behavioural Inattention Test (+exp1, +exp2) E1 vs E2 • Reading test A and Writing Tasks (-) • Behavioural Inattention Test (-)
Optokinetic Stimulation + Cueing vs. General neuropsychological treatment		
Bode et al. (2023) RCT (6) N_{Start}=32 N_{End}=20 TPS=Subacute	E: Optokinetic stimulation + Cue-assisted reading therapy (OKSREAD) C: General neuropsychological treatment Duration: 45min/d for 15 daily sessions	• Catherine Bergego Scale (-) • Customized neuropsychological test battery (Neuropsychological test accuracy %) (+exp) • Text reading (-) • Bells test (-) • Line bisection (-) • Posner task (-) • Visual search (-) • Free viewing task (+exp)

Abbreviations and table notes: C=control group; D=days; E=experimental group; H=hours; Min=minutes; RCT=randomized controlled trial; TPS=time post stroke category (Acute: less than 30 days, Subacute: more than 1 month but less than 6 months, Chronic: over 6 months); Wk=weeks.
+exp indicates a statistically significant between groups difference at α=0.05 in favour of the experimental group
+exp_2 indicates a statistically significant between groups difference at α=0.05 in favour of the second experimental group
+con indicates a statistically significant between groups difference at α=0.05 in favour of the control group
- indicates no statistically significant between groups differences at α=0.05

Conclusions about optokinetic stimulation

VISUOSPATIAL PROCESSING & USN			
LoE	**Conclusion Statement**	**RCTs**	**References**
1b	**Optokinetic stimulation with eye patching** may not have a difference in efficacy compared to **Usual care** for improving neglect.	2	Wang et al., 2015; Machner et al., 2014
1b	**Optokinetic stimulation + visual scanning training** may produce greater improvements in neglect than **visual scanning training alone**.	2	Kerkhoff et al., 2012; Schroder et al., 2008

2	**Optokinetic stimulation** may not have a difference in efficacy compared to **standard neglect rehabilitation** for improving neglect.	1	Pizzamiglio et al., 2004
2	**Optokinetic stimulation with cue-assisted reading** may not have a difference in efficacy compared to **general neuropsychological treatment** for improving neglect.	1	Bode et al., 2023

NEGLECT- SPECIFIC ADLs			
LoE	**Conclusion Statement**	**RCTs**	**References**
1b	**Optokinetic stimulation with eye patching** may not have a difference in efficacy compared to **usual care** for improving neglect-specific of ADLs.	1	Machner et al., 2014
2	**Optokinetic stimulation** may not have a difference in efficacy compared to **standard neglect rehabilitation** for improving neglect-specific ADLs.	1	Pizzamiglio et al., 2004
2	**Optokinetic stimulation with cue-assisted reading** may not have a difference in efficacy compared to **general neuropsychological treatment** for improving neglect-specific ADLs.	1	Bode et al., 2023

GENERAL ADLs			
LoE	**Conclusion Statement**	**RCTs**	**References**
1b	**Optokinetic stimulation with eye patching** may not have a difference in efficacy compared to **usual care** for improving general ADLs.	1	Machner et al., 2014

Key Points

Optokinetic stimulation added to visual scanning may be beneficial for improving USN compared to visual scanning alone.

Optokinetic stimulation with or without eye patching may not be beneficial in improving USN, neglect-specific ADLs, or general ADLs compared to conventional neglect rehabilitation or usual care.

Functional Electric Stimulation

Adapted from: https://www.researchgate.net/figure/Contralaterally-controlled-functional-electrical-stimulation-system-Volitional-opening_fig1_51603829

Functional Electric Stimulation (FES) is a motor rehabilitation technique that has been used to improve motor control of neurologically impaired motor systems, and to facilitate the return to voluntary movement in individuals with conditions such as hemiplegia, spinal cord, multiple sclerosis, etc. (Singer, 1987). Previous research found that passive movement to the contralesional limb in the contralesional hemispace may be beneficial for individuals with spatial neglect (Robertson & North, 1993). Passive movement of the affected limb can be induced through FES, allowing the individual to observe the flexion and extension of the limb during the application of the technique (Harding & Riddoch, 2009). During FES, electrical stimulation applied to the muscles that, when contracted, produce a functional movement, such as lifting or holding an object (Marquez-Chin & Popovic, 2020). The use of FES facilitates the generation of passive movement, and it is potentially viable to treat spatial neglect (Eskes & Butler, 2006). However, the benefit of electrical stimulation for spatial neglect post stroke should be approached with caution given the small number of trials, participants, and the high risk of bias (Longley et al., 2023).

One RCT was found to evaluate FES combined with prism adaptation compared to either FES or prism adaptation alone (Choi et al., 2019).

The methodological details and results the RCT is presented in Table 16.

Table 16. RCTs evaluating functional electrical stimulation interventions for neglect rehabilitation.

Authors (Year) Study Design (PEDro) Sample Size$_{start}$ Sample Size$_{end}$ Time post stroke	Interventions Duration: Session length, frequency per week for total number of weeks	Outcome Measures Result (direction of effect)
Functional Electrical Stimulation + Prism Adaptation		

Choi et al. (2012) RCT (5) N_{Start}=30 N_{End}=30 TPS=Subacute	E1: Prism Adaptation + Functional Electrical Stimulation E2: Prism Adaptation E3: Functional Electrical Stimulation Duration: 50min/d, 5d/wk for 3wks	E1 vs E2/E3 • Albert Test (+exp1) • Motor-Free Visual Perception Test (+exp1) • Catherine Bergego Scale (+exp1)

Abbreviations and table notes: C=control group; D=days; E=experimental group; H=hours; Min=minutes; RCT=randomized controlled trial; TPS=time post stroke category (Acute: less than 30 days, Subacute: more than 1 month but less than 6 months, Chronic: over 6 months); Wk=weeks.
+exp indicates a statistically significant between groups difference at α=0.05 in favour of the experimental group
+exp_2 indicates a statistically significant between groups difference at α=0.05 in favour of the second experimental group
+con indicates a statistically significant between groups difference at α=0.05 in favour of the control group
- indicates no statistically significant between groups differences at α=0.05

Conclusions about functional electric stimulation

VISUOSPATIAL PROCESSING & USN			
LoE	**Conclusion Statement**	**RCTs**	**References**
2	**Prism Adaptation + Functional Electrical Stimulation** may produce greater improvements in neglect than **either therapy alone.**	1	Choi et al., 2019

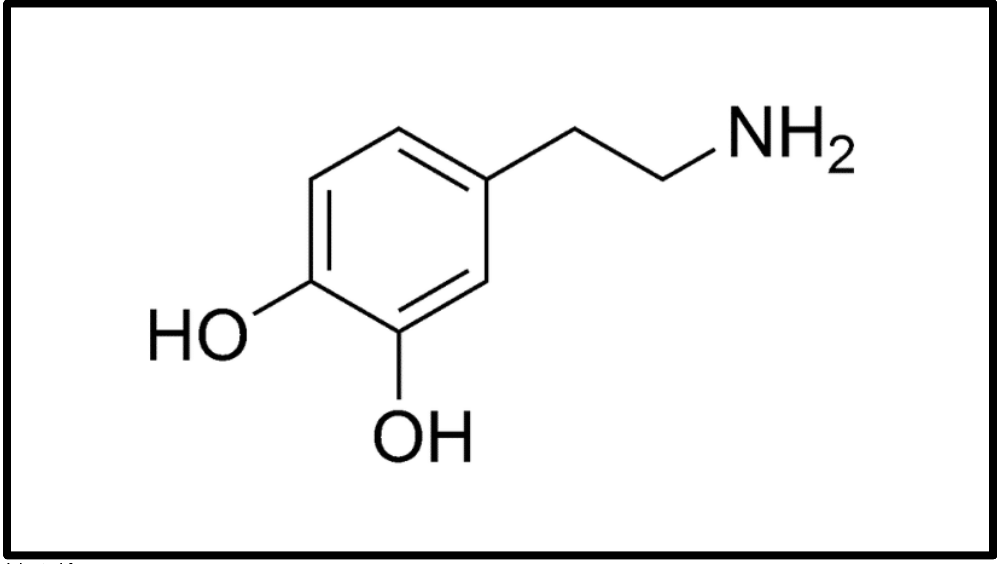
NEGLECT- SPECIFIC ADLs			
LoE	**Conclusion Statement**	**RCTs**	**References**
2	**Prism Adaptation + Functional Electrical Stimulation** may produce greater improvements in neglect-specific ADLs than **either therapy alone.**	1	Choi et al., 2019

Key Points

FES combined with prism adaptation may be beneficial for improving USN and neglect-specific ADLs when compared to either FES or prism adaptation alone.

Pharmacological Interventions

Dopaminergic Medication Therapy



Adapted from: https://examinedexistence.com/what-is-dopamine-and-what-is-its-function/

Marshall & Gotthelf (1979), as cited in (Pierce & Buxbaum, 2002), reported that a reduced level of dopamine, a neurotransmitter, has been identified as playing a role in the arousal and orientation to stimuli. Hurford et al. (1998) reported a single case study of a patient with USN who received two consecutive treatments; methylphenidate followed by bromocriptine. While treatment with methylphenidate resulted in some improvement of neglect symptoms, bromocriptine, a dopamine agonist, was associated with greater improvement. While being treated with bromocriptine (5 mg, 3 times daily), performance on line bisection, letter cancellation and star cancellation tests improved such that results fell within the range of normal scores (Hurford et al., 1998). Improvements in performance were sustained or increased following cessation the medication regime and anecdotal reports were provided of improvements in everyday function (Hurford et al., 1998).

Two RCTs were found evaluating dopaminergic medication interventions for improving neglect (Gorgoraptis et al., 2012; Li et al., 2020).

The methodological details and results of 2 RCTs are presented in Table 17.

Table 17. RCTs evaluating dopaminergic medication interventions for neglect rehabilitation.

Authors (Year) Study Design (PEDro) Sample Size$_{start}$ Sample Size$_{end}$ Time post stroke	Interventions Duration: Session length, frequency per week for total number of weeks	Outcome Measures Result (direction of effect)
Li et al. (2020) RCT (6) N_{Start}=9 N_{End}=9 TPS=Chronic	E1: Co-careldopa Followed by Reward E2: Co-careldopa with No Reward C1: Placebo Followed by Reward C2: Placebo with No Reward Single dose, crossover, 1wk washout	E1 vs C1 • Mesulam shape cancellation (-) • Behavioural Inattention Test, cancellation tasks (-) E2 vs C2 • Mesulam shape cancellation (+exp2) • Behavioural Inattention Test, cancellation tasks (+exp2)

Gorgoraptis et al. (2012) RCT (8) N_{Start}=16 N_{End}=16 TPS=Chronic	E: Rotigotine (9.0mg skin patch) C: Placebo Duration: 6d no treatment, 8d treatment (4mg/24hr), 6d no treatment	• Line Bisection Test (-) • Target Cancellation (+exp) • Corsi Spatial Span Test (-) • Visual Salience Task (-) • Vigilance Task (-)

Abbreviations and table notes: C=control group; D=days; E=experimental group; H=hours; Min=minutes; RCT=randomized controlled trial; TPS=time post stroke category (Acute: less than 30 days, Subacute: more than 1 month but less than 6 months, Chronic: over 6 months); Wk=weeks.
+exp indicates a statistically significant between groups difference at α=0.05 in favour of the experimental group
+exp_2 indicates a statistically significant between groups difference at α=0.05 in favour of the second experimental group
+con indicates a statistically significant between groups difference at α=0.05 in favour of the control group
- indicates no statistically significant between groups differences at α=0.05

Conclusions about dopaminergic medications

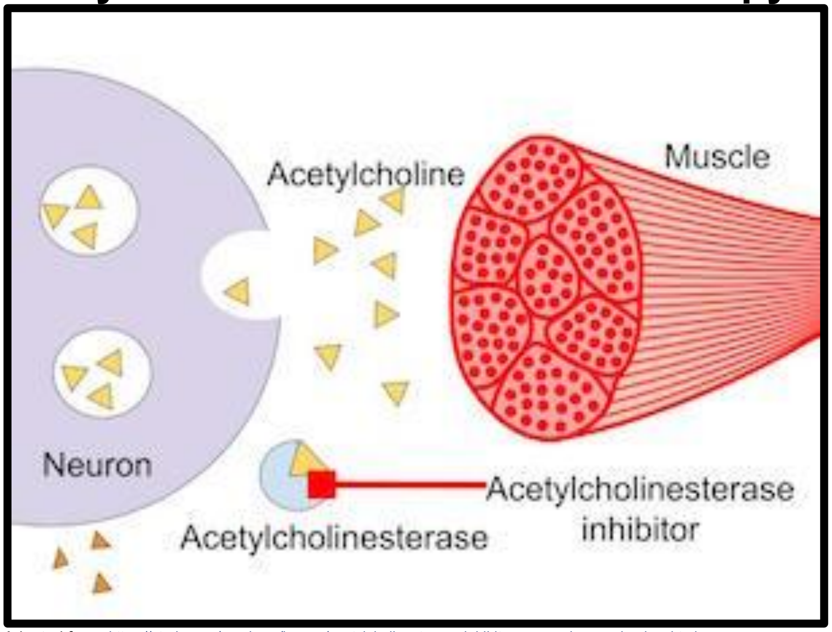
VISUOSPATIAL PROCESSING & USN			
LoE	**Conclusion Statement**	**RCTs**	**References**
1a	The evidence is mixed regarding the beneficial effect of **dopaminergic medications** compared to a **placebo** for improving neglect.	2	Li et al., 2020; Gorgoraptis et al., 2012

GLOBAL COGNITION			
LoE	**Conclusion Statement**	**RCTs**	**References**
1b	**Rotigotine** may not have a difference in efficacy compared to a **placebo** for improving global cognition.	1	Gorgoraptis et al., 2012

Key Points

The evidence is mixed regarding the beneficial effect of dopaminergic medications compared to a placebo for improving USN.

Acetylcholinesterase Inhibitor Therapy



Adapted from: https://study.com/academy/lesson/acetylcholinesterase-inhibitors-examples-mechanism.html

Acetylcholinesterase inhibitors, (rivastigmine, donepezil and galantamine) which have been used in the treatment of Alzheimer's disease, act by preventing the breakdown of acetylcholine, therefore causing levels to increase (Narasimhalu et al., 2010). These drugs have been used in association with treatments for cognitive disorders and may help improve cognitive functioning (Narasimhalu et al., 2010; Whyte et al., 2008).

Treatment with the acetylcholinesterase inhibitor rivastigmine in conjunction with cognitive training was associated with significant improvement on assessments of USN (Paolucci et al., 2010). Gains appeared to be maintained one-month following treatment, while individuals in the control group continued to improve over time to reach comparable levels. Further study is required to determine if acetylcholinesterase inhibitors are an effective method of rehabilitation for neglect.

One RCT was found evaluating acetylcholinesterase inhibitors for neglect rehabilitation. It compared rivastigmine with physical therapy and cognitive training to cognitive training alone (Paolucci et al., 2010).

The methodological details and results of the single RCT are presented in Table 18.

Table 18. RCTs evaluating acetylcholinesterase Inhibitor interventions for neglect rehabilitation.

Authors (Year) **Study Design (PEDro)** **Sample Size$_{start}$** **Sample Size$_{end}$** **Time post stroke**	**Interventions** **Duration: Session length, frequency per week for total number of weeks**	**Outcome Measures** **Result (direction of effect)**
Paolucci et al. (2010) RCT (7) N_{start}=20 N_{end}=20 TPS=Acute Pilot	E: Rivastigmine Therapy + cognitive rehabilitation for USN C: cognitive rehabilitation for USN (1hr/d, 5d/wk) Duration: 3mg, 2x/d (orally) for 8wks	• Letter Cancellation Test (+exp) • Wundt-Jastrow Area Illusion Test (+exp) • Albert's Barrage Test (-) • Sentence Reading Test (-) • Barthel Index (-)

Abbreviations and table notes: C=control group; D=days; E=experimental group; H=hours; Min=minutes; RCT=randomized controlled trial; TPS=time post stroke category (Acute: less than 30 days, Subacute: more than 1 month but less than 6 months, Chronic: over 6 months); Wk=weeks.
+exp indicates a statistically significant between groups difference at α=0.05 in favour of the experimental group

+exp2 indicates a statistically significant between groups difference at α=0.05 in favour of the second experimental group
+con indicates a statistically significant between groups difference at α=0.05 in favour of the control group
- indicates no statistically significant between groups differences at α=0.05

Conclusions about acetylcholinesterase inhibitors

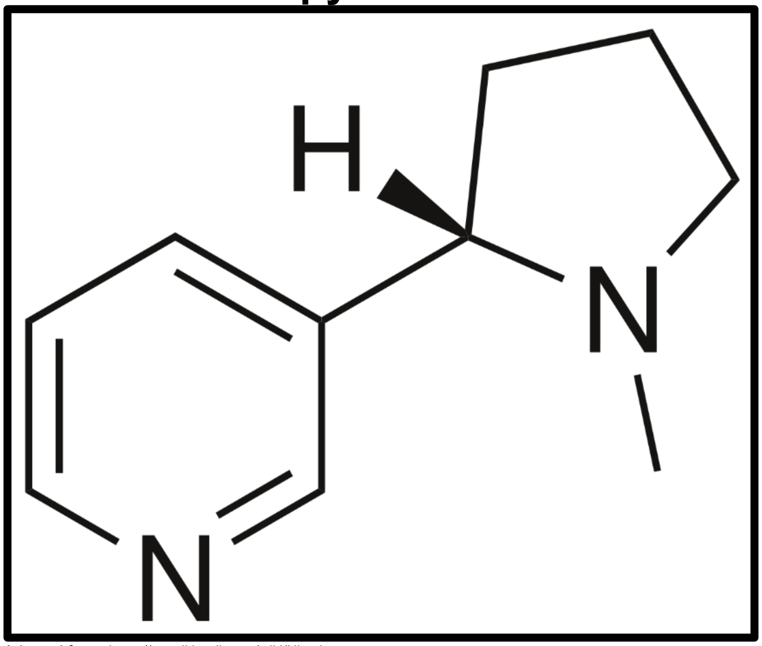
VISUOSPATIAL PROCESSING & USN			
LoE	**Conclusion Statement**	**RCTs**	**References**
1b	There is conflicting evidence about the use **rivastigmine added to cognitive training** for improving neglect when compared to **cognitive training alone**.	1	Paolucci et al., 2010

GENERAL ADLs			
LoE	**Conclusion Statement**	**RCTs**	**References**
1b	**Rivastigmine added to cognitive training** may not have a difference in efficacy compared to **cognitive training alone** for improving general ADLs.	1	Paolucci et al., 2010

Key Points

The literature is mixed for the effect of rivastigmine combined with cognitive rehabilitation on improving USN when compared to cognitive rehabilitation alone.

Nicotine Therapy



Adapted from: https://en.wikipedia.org/wiki/Nicotine

Nicotine therapies are based around the same principles as acetylcholinesterase inhibitors. Findings from neuroimaging and behavioural studies in animals and healthy humans suggest that the cholinergic system may be involved in selective and focused attention (Lucas et al., 2013). Nicotine, a powerful cholinergic agonist, could potentially modulate activity in frontal and parietal areas and lead to improvements in USN.

One RCT was found evaluating nicotine interventions for neglect rehabilitation. It compared nicotine to a placebo (Lucas et al., 2013).

The methodological details and results of the single RCT are presented in Table 19.

Table 19. RCTs evaluating nicotine interventions for neglect rehabilitation.

Authors (Year) Study Design (PEDro) Sample Size$_{start}$ Sample Size$_{end}$ Time post stroke	Interventions Duration: Session length, frequency per week for total number of weeks	Outcome Measures Result (direction of effect)
Lucas et al. (2013) Cross-over RCT (8) N_{Start}=10 N_{End}=10 TPS=Chronic	E: Nicotine (10mg nicotine patch) C: Placebo Duration: 1 dose, 24hr washout	• Letter Cancellation Test (+exp) • Shape Cancellation Test (+exp) • Bell's Cancellation Test (+exp) • Compound-word reading Task (-) • Line Bisection Test (-)

Abbreviations and table notes: C=control group; D=days; E=experimental group; H=hours; Min=minutes; RCT=randomized controlled trial; TPS=time post stroke category (Acute: less than 30 days, Subacute: more than 1 month but less than 6 months, Chronic: over 6 months); Wk=weeks.
+exp indicates a statistically significant between groups difference at α=0.05 in favour of the experimental group
+exp$_2$ indicates a statistically significant between groups difference at α=0.05 in favour of the second experimental group
+con indicates a statistically significant between groups difference at α=0.05 in favour of the control group
- indicates no statistically significant between groups differences at α=0.05

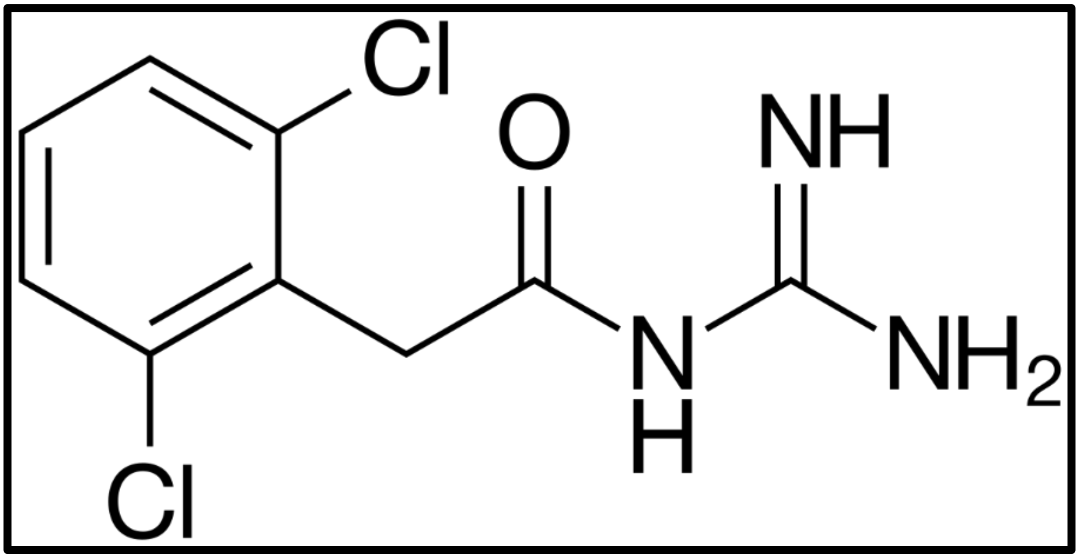
Conclusions about acetylcholinesterase inhibitors

VISUOSPATIAL PROCESSING & USN			
LoE	**Conclusion Statement**	**RCTs**	**References**
1b	There is conflicting evidence about the use **nicotine patches** for improving neglect when compared to **placebo**.	1	Lucas et al., 2013

Key Points

The evidence is mixed for the effect of Nicotine patch treatment for improving USN when compared to placebo.

Guanfacine



Adapted from: https://en.wikipedia.org/wiki/Guanfacine

Guanfacine (Tenex) is a drug used to treat attention deficit hyperactivity disorder (ADHD) and high blood pressure. It is an adrenergic alpha-2A receptor agonist, increasing parasympathetic activity. Vigilance as a cognitive function has been linked to the adrenergic system (Aston-Jones et al., 1994; Smith & Nutt, 1996). The dug has been shown to increase attention, and working memory in healthy humans (Biederman et al., 2008; Jäkälä et al., 1999). Because of this, it has the potential to be a successful pharmacological intervention for treating neglect post-stroke.

One RCT was found evaluating guanfacine interventions for neglect rehabilitation. It compared guanfacine to a placebo (Dalmaijer et al., 2018).

The methodological details and results of the single RCT are presented in Table 20.

Table 20. RCTs evaluating guanfacine interventions for neglect rehabilitation.

Authors (Year) Study Design (PEDro) Sample Size$_{start}$ Sample Size$_{end}$ Time post stroke	Interventions Duration: Session length, frequency per week for total number of weeks	Outcome Measures Result (direction of effect)
Dalmaijer et al. 2018 RCT Crossover (6) N_{start}=13 N_{end}=13 TPS=Chronic	E: Oral guanfacine (2mg) C: Oral placebo (2mg) Duration: One-time dose, one-day washout	• Cancellation Task (+exp) • Directional Attention Bias (-) ○ Cancelled targets on right (-) ○ Cancelled targets on left (-) ○ Centre of cancellation (-)

Abbreviations and table notes: C=control group; D=days; E=experimental group; H=hours; Min=minutes; RCT=randomized controlled trial; TPS=time post stroke category (Acute: less than 30 days, Subacute: more than 1 month but less than 6 months, Chronic: over 6 months); Wk=weeks.
+exp indicates a statistically significant between groups difference at α=0.05 in favour of the experimental group
+exp$_2$ indicates a statistically significant between groups difference at α=0.05 in favour of the second experimental group
+con indicates a statistically significant between groups difference at α=0.05 in favour of the control group
- indicates no statistically significant between groups differences at α=0.05

Conclusions about guanfacine

VISUOSPATIAL PROCESSING & USN			
LoE	**Conclusion Statement**	**RCTs**	**References**
1b	There is conflicting evidence about the use of **guanfacine** for improving neglect when compared to **a placebo.**	1	Dalmaijer et al., 2018

Key Points

> The literature is mixed regarding the beneficial effect of guanfacine compared to placebo for improving USN.

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