Evidenced-Based Cognitive Rehabilitation of Hemispatial Neglect

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Improving lives through interdisciplinary rehabilitation research

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DISCLOSURES

Deirdre Dawson, PhD, OT Reg. (Ont.) has the following disclosures:

- Has received research grants to investigate the Cognitive Orientation to daily Occupational Performance Approach™
- Is a CO-OP Certified Instructor
- Has a book contract with the AOTA press for a book on the CO-OP Approach™ (available Nov. 2017)

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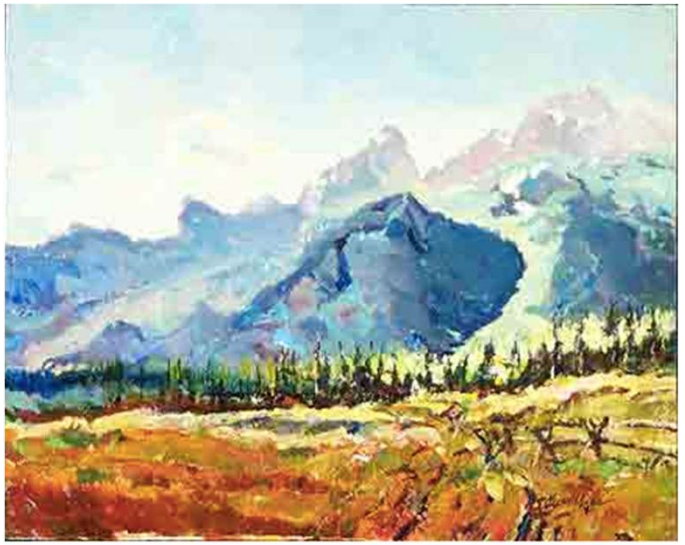
CREATURE
FROM THE
BLACK LAGOON
starring
RICHARD CARLSON · JULIA ADAMS
with
RICHARD DENNING · ANTONIO MORENO
NESTOR PAIVA · WHIT BISSELL
DIRECTED BY JACK ARNOLD · SCREENPLAY BY HARRY ESSEX AND ARTHUR ROSS · PRODUCED BY WILLIAM ALLAND · A UNIVERSAL-INTERNATIONAL PICTURE

Reynold Brown (1917-1991)

- R-hemispheric stroke 1976



Behavioral – Learning Objectives

At the activity conclusion, the participant will be able to:

1. ***Identify functional examples of hemispatial neglect following brain injury.***
2. ***Have knowledge of current evidence-based recommendations for the treatment of hemispatial neglect following brain injury.***
3. ***Understand and know how to apply the principles and systematic cuing that guide scanning training for hemispatial neglect.***
4. ***Understand and know how to apply the use of a direct, functional scanning training for hemispatial neglect.***
5. ***Understand and know how to apply the use of limb activation techniques in treating hemispatial neglect.***

What is hemi-spatial neglect?

- Behavioural bias directed ipsilaterally to damaged hemisphere and loss of awareness for contralesional side
- Not specific to vision, a heterogeneous disorder with suptypes (Rode et al., 2017, *Ann Phys Rehabil Med*)
- “primary deficit … is related to attention, not perception, …does lead to deficits in awareness of the perceptual world” (Ward, J. (2015). *The student’s guide to cognitive neuroscience*.)

Types of Neglect*

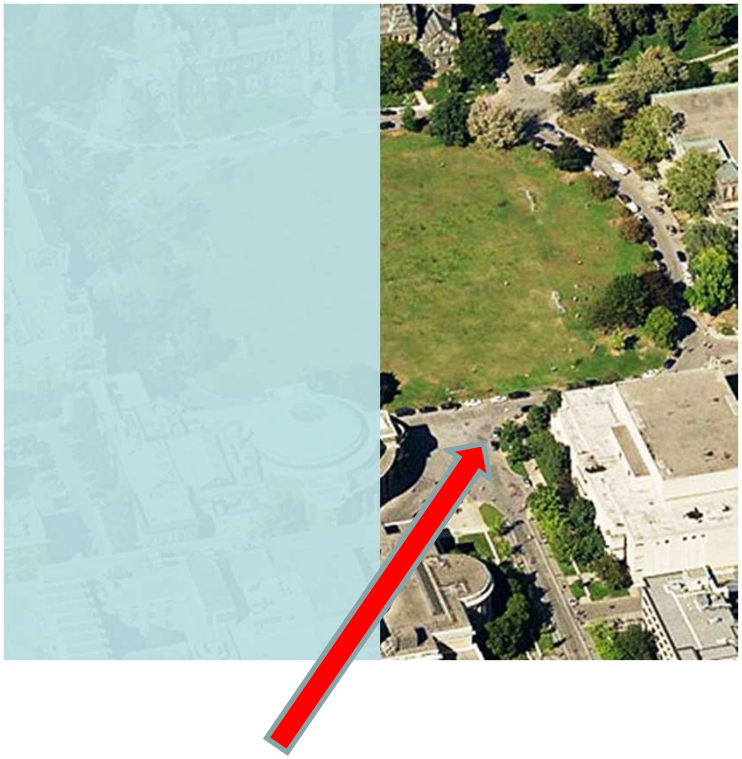
1. **Sensory attention neglect** (visual, auditory, somatasensory)
   - VN – unable to detect or respond to stimuli in contralesional field

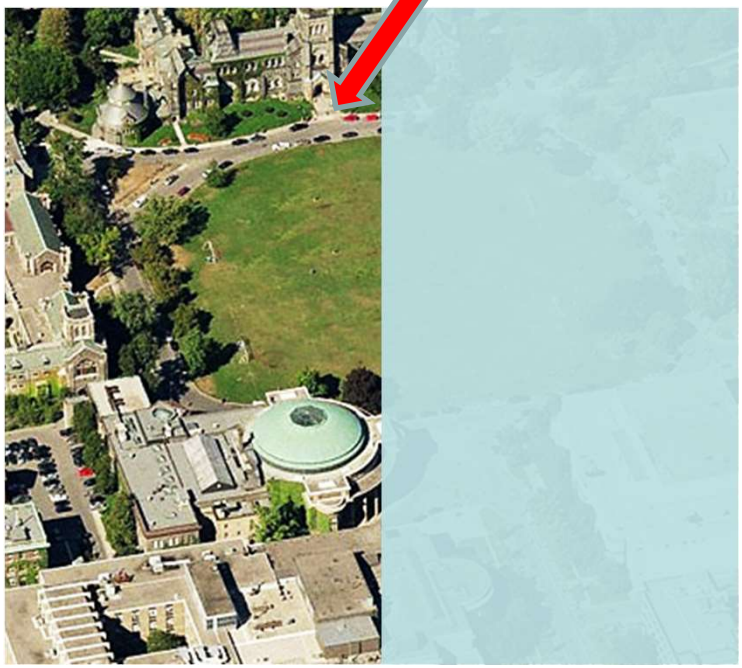
2. **Motor neglect** (in absence of sensory-motor impairments)
   - Paucity of movement

3. **Representational Neglect** - relates to imagining space, i.e., imaging space from a set point of view

Rode et al., 2017, Ann Phys Rehabil Med, 60 (3)

Representational Neglect





Types of Neglect

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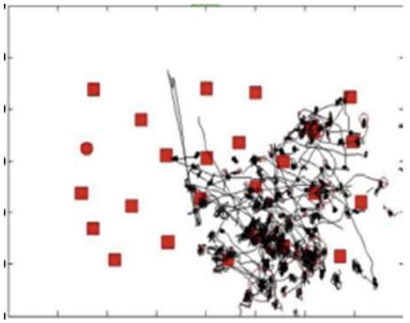
   - VN – unable to detect or respond to stimuli in contralesional field
2. **Motor neglect** (in absence of sensory-motor impairments)
   - Paucity of movement
3. **Representational Neglect** - typically relates to allocentric space, i.e., a map of space coding locations of objects relative to each other
   - involves imaging space
4. **Visuo-spatial Neglect**

Type	Description	Example	Space
Personal	- Body representation difficulties	e.g., neglects to wash one side of face	- Egocentric (self-centred)
Peri-personal	- Within arms reach (including with pointer…)	e.g., not eating food on one side of the plate	- Egocentric
Extra-personal	- Beyond arms' reach	e.g., bumping into doorways	- Egocentric & allocentric (object-centred) - near & far

Characteristics of Neglect

- Reduced orienting to neglected space when there are competing stimuli
- Omissions of stimuli in contra-lesional space
- Distortions of stimuli in contra-lesional space
- Perseverations in drawing or space exploration



Theoretical Framework for Unilateral Neglect Rehabilitation Approaches*

- **Top-down approaches** – require voluntary effort / endogenous orienting by client
  - Visual scanning
  - Lighthouse approach
  - Visual Imagery
  - Self-instruction Training
- **Bottom-up approaches** – involve manipulation of sensory environment / exogenous orienting
  - Prism adaptation
- **Modulation of intracerebral inhibition processes**
  - Transcranial magnetic stimulation
- **Stimulation of arousal**
  - Attentional stimuli (e.g., tapping desk randomly and saying 'attention'
- **Combined approaches**
  - Limb activation - combines voluntary effort with sensory input
  - Music making?
  - CIMT
  - Mirror therapy

Azouvi et al., 2017, Ann Phys Rehabil Med

Hemispatial Neglect
Evidence-Based Recommendations (updated)

Practice Standard

- Visuospatial rehabilitation that includes **visual scanning training** is recommended for left visual neglect after right hemisphere stroke

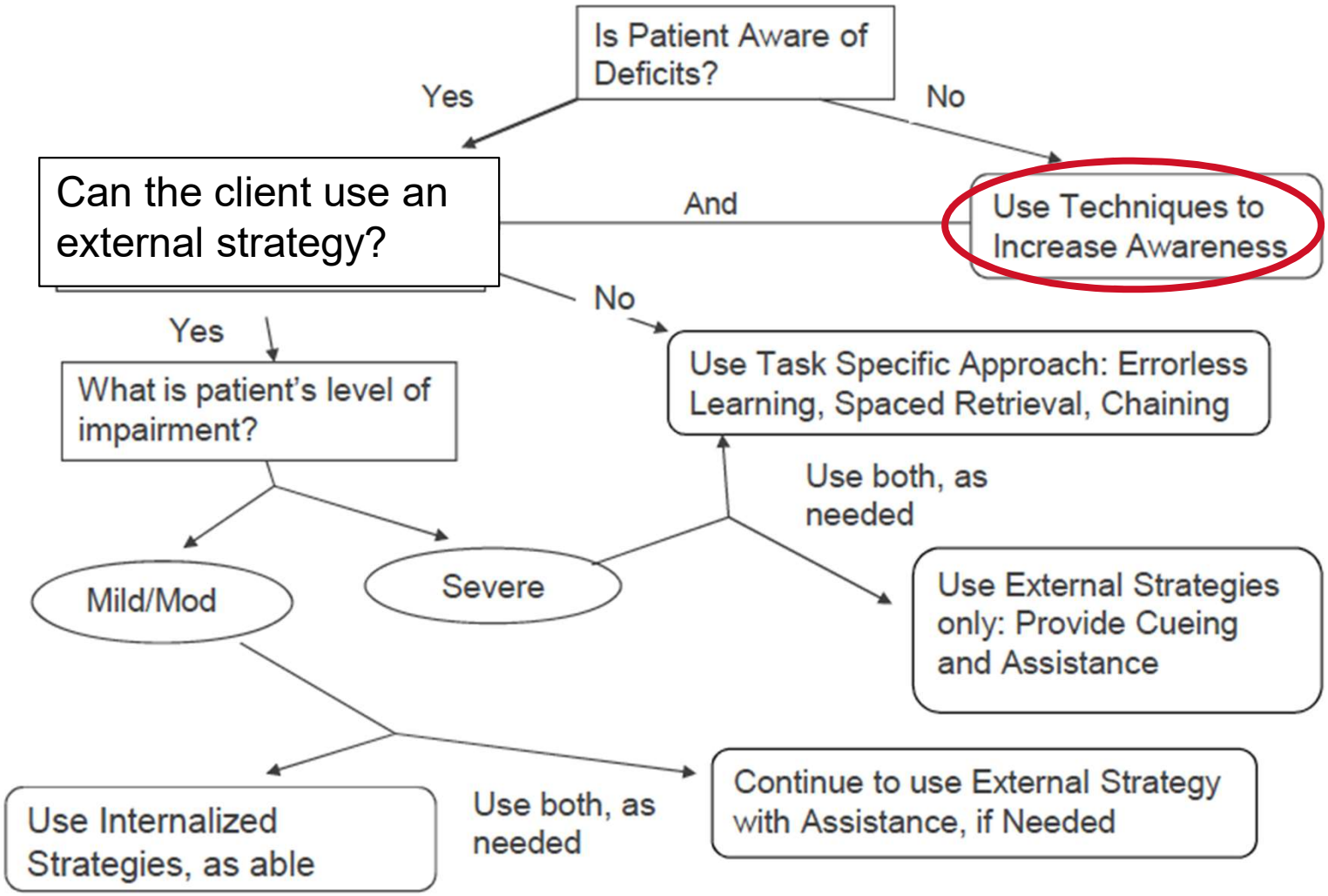
Practice Guideline

- Isolated microcomputer exercises to treat left neglect after stroke appears **not effective & is not recommended**
- **Left hand stimulation** or forced **limb activation** may be combined with visual scanning training to increase the efficacy of treatment for neglect after right hemisphere stroke

Practice Option

- **Electronic technologies for visual scanning** training may be included in the treatment of neglect after right hemisphere stroke

Figure 1.1, p. 12



Top-down Methods:
Visual Scanning Training

Current Evidence (Azouvi et al., 2017)

Reference	Method	Top-down/bottom-up	Patients included	Functional outcome
Antonucci et al., 1995 [47]	VST vs. general cognitive rehabilitation	Top-down	20	Reading, copying
Chemey et al., 2003 [48]	VST vs. repetitive practice of a functional task	Top-down	4	BIT, functional reading test
Edmans et al., 2000 [49]	Cueing and feedback vs. functional approach	Top-down	42	BI, Edmans ADL scale; RPAB
Fanthome et al., 1995 [50]	Feedback of eye movements (adapted glasses with auditory signals) vs. no treatment	Top-down	18	Behavioural BIT
Ferreira et al., 2011 [51]	VST vs. mental practice	Top-down	10	FIM
Gordon et al., 1985 [52]	VST vs. classical OT	Top-down	77	Reading; copying
Harvey et al., 2003 [53]	Feedback vs. visuomotor training	Top-down	14	Behavioural BIT; BI
Paolucci et al., 1996 [54]	VST vs. general cognitive rehabilitation	Top-down	23	BI
Robertson et al., 1990 [55]	Computerized VST vs. recreational computing	Top-down	30	Behavioural BIT
Weinberg et al., 1977 [56]	VST vs. routine OT	Top-down	25	Reading and copying
Welfringer et al., 2011 [57]	Visuomotor imagery therapy + classical rehabilitation vs. classical rehabilitation	Top-down	30	Arm functions tests
Young et al., 1983 [58]	VST vs. classical OT	Top-down	27	Reading; copying
Fong et al., 2015 [36]	Pursuit eye training group vs. VST	Bottom-up	24	Functional neglect index;

Visual Scanning Training
Common Behaviors & Treatment Principles

(Weinberg et al., 1977)

1. **Locus of the Stimulus**
   - Stimuli on left side of space are more likely to be omitted than stimuli on right
2. **Anchoring**
   - Verbal and visual cues to begin at far left side
3. **Pacing**
   - Tendency for rapid drifting toward targets on right side of page
   - Ask patients to recite targets aloud

Visual Scanning Training
Common Behaviors & Treatment Principles
(Weinberg et al., 1977)

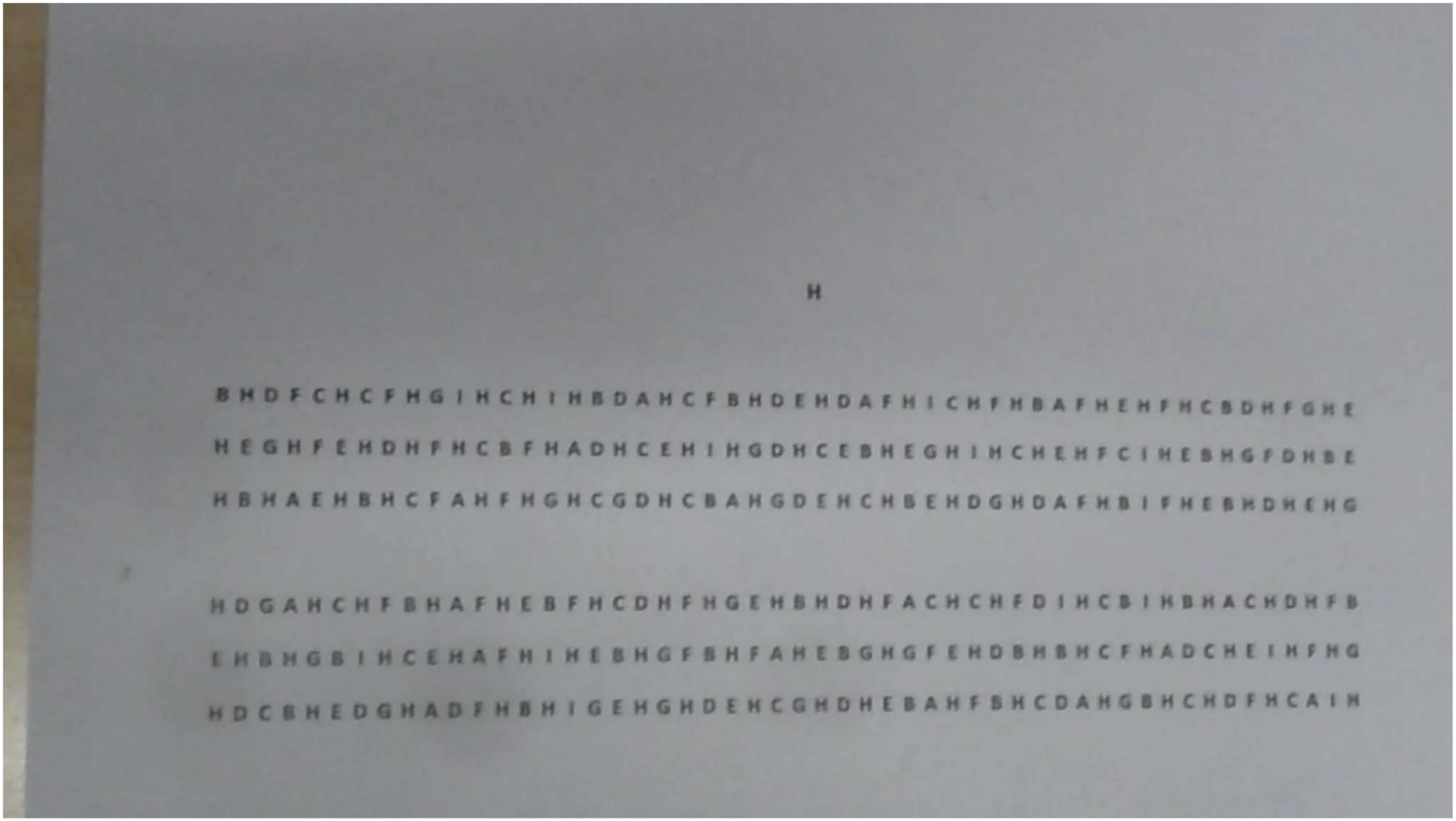
4. **Density**
   - Errors tend to occur with targets close together
5. **Information Load**
   - Complexity increases task demands
   - Visual search for two targets is more difficult than one
6. **Performance Prediction and Feedback**
   - To build awareness of difficulties:
     - Ask patient to predict performance results
     - Provide feedback on performance

Visual Scanning Training
Assessment

- **Scanning Task (Diller et al., 1980)**
  - **"H" Form**
    - **11" x 8.5" paper containing 6 lines of 52 letters/line**
    - **"H" randomly appears 105 times on page**
    - **Scored based on omissions, commissions, time**
  - **"C & E Form"**
    - **11" x 8.5" paper containing 6 lines of 52 letters/line**
    - **"C" and "E" randomly appear 105 times on page**
    - **Scored based on omissions, commissions, time**

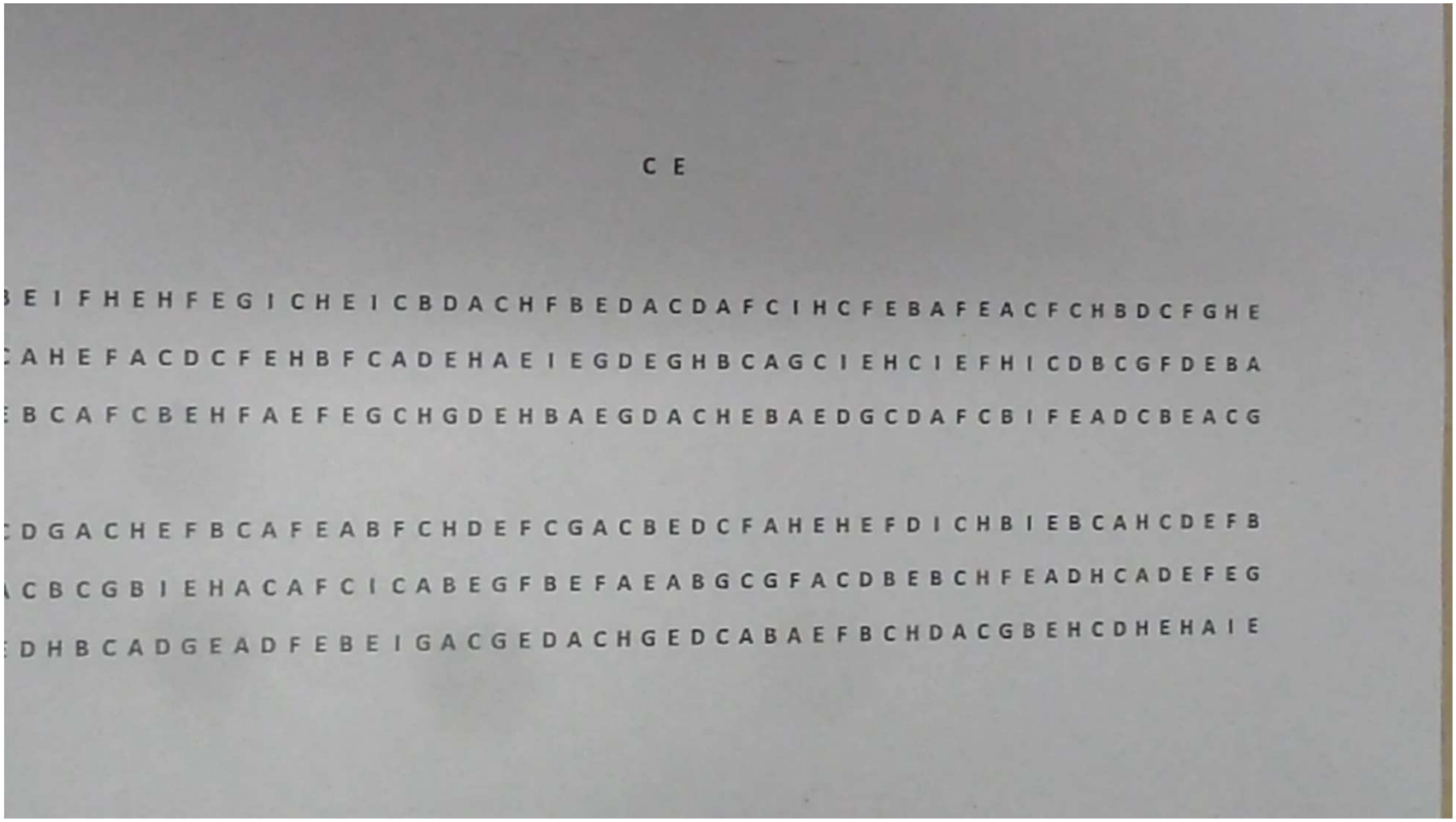
Visual Scanning Training

Assessment – 1 stimulus



Visual Scanning Training

Assessment – 2 Stimuli



Visual Scanning Training
Training

- **Scanning Task (Diller et al., 1980)**
  - "8" Form
    - 11" x 8.5" paper containing 6 lines of 52 numbers/line
    - "8" randomly appears 105 times on page
    - Scored based on omissions, commissions, time
  - "3 & 5" Form
    - 11" x 8.5" paper containing 6 lines of 52 numbers/line
    - "3" and "5" randomly appear 105 times on page
    - Scored based on omissions, commissions, time

Visual Scanning Training

Levels of Visual Cueing

Level 1:

- Vertical anchoring line on left side
- Sequential numbering on left & right margins

Level 2:

- Vertical anchoring line on left side
- Sequential numbering on left margin only

Level 3:

- Vertical anchoring line on left side

Level 4:

- No cues

*Auditory, gestural and physical cueing may be added and should be graded in a similar fashion

Visual Scanning Training
Systematic/Orderly Sequence

1. **Establish client's understanding of problem**
   - To improve basic scanning ability
   - To decrease impulsivity
   - **To improve reading ability and other similar functional difficulties**

2. **Gather and prepare materials**
   - Start with single-stimulus page
   - Tape page to flat working surface, if needed
   - Add needed cuing structure

Visual Scanning Training
Systematic/Orderly Sequence

3. Training Steps:

- Draw vertical line on left to *anchor* left field
- Orient patient to left anchor line, and #1 next to line
- Ask client to scan from left to right along first horizontal line of numbers:
  - **reading all numbers *aloud***
  - **crossing out each "8"**
- Observe client and correct if s/he:
  - **Skips any "8s"**
  - **Misreads/omits any number while reading**
- Ask client to scan back to left to start next line:
  - **Note number at end of line**
  - **Scan visually to left**
  - **Find anchor line**
  - **Use numbers to orient to beginning of next line**

Visual Scanning Training
Systematic/Orderly Sequence

4. **Performance Criteria on Single-stimulus Task:**

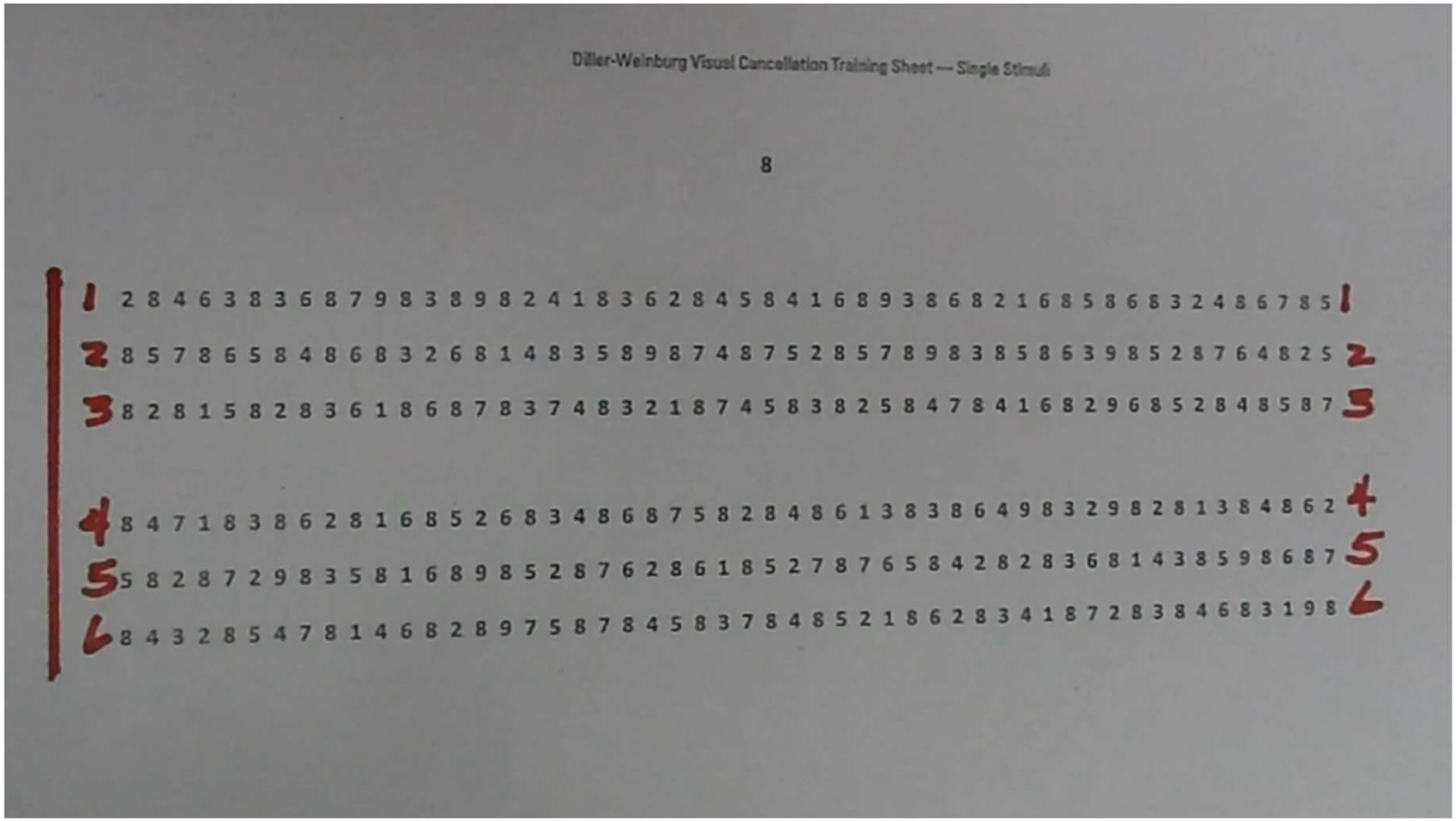
   - For mildly impaired clients
     - **Less than 4 errors scattered throughout**

   - For severely impaired clients
     - **Less than or equal to 1/3 of errors on "H" test scattered throughout**

Visual Scanning Training

Systematic/Orderly Sequence

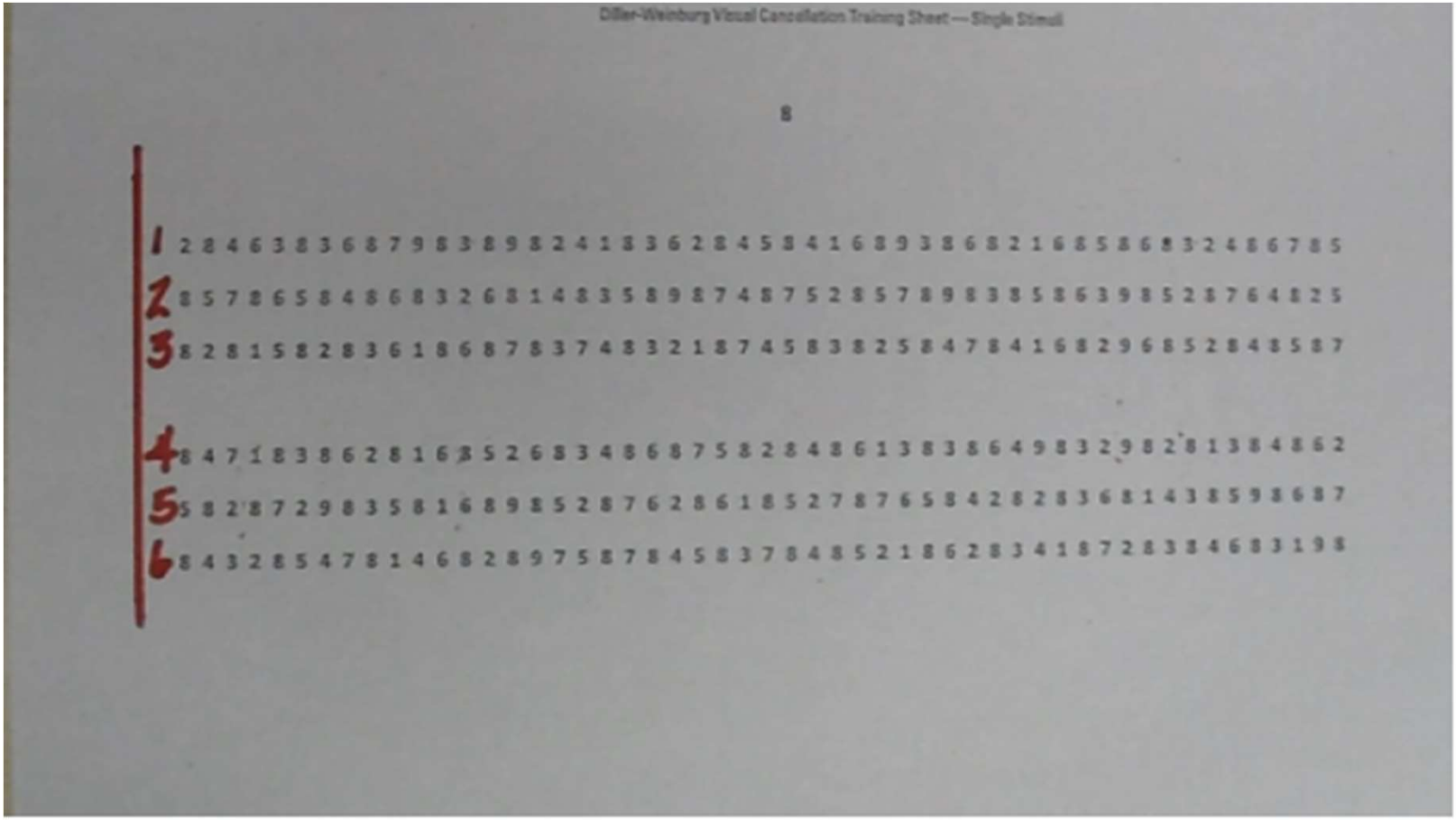
1 stimulus – all cues



Visual Scanning Training

Systematic/Orderly Sequence

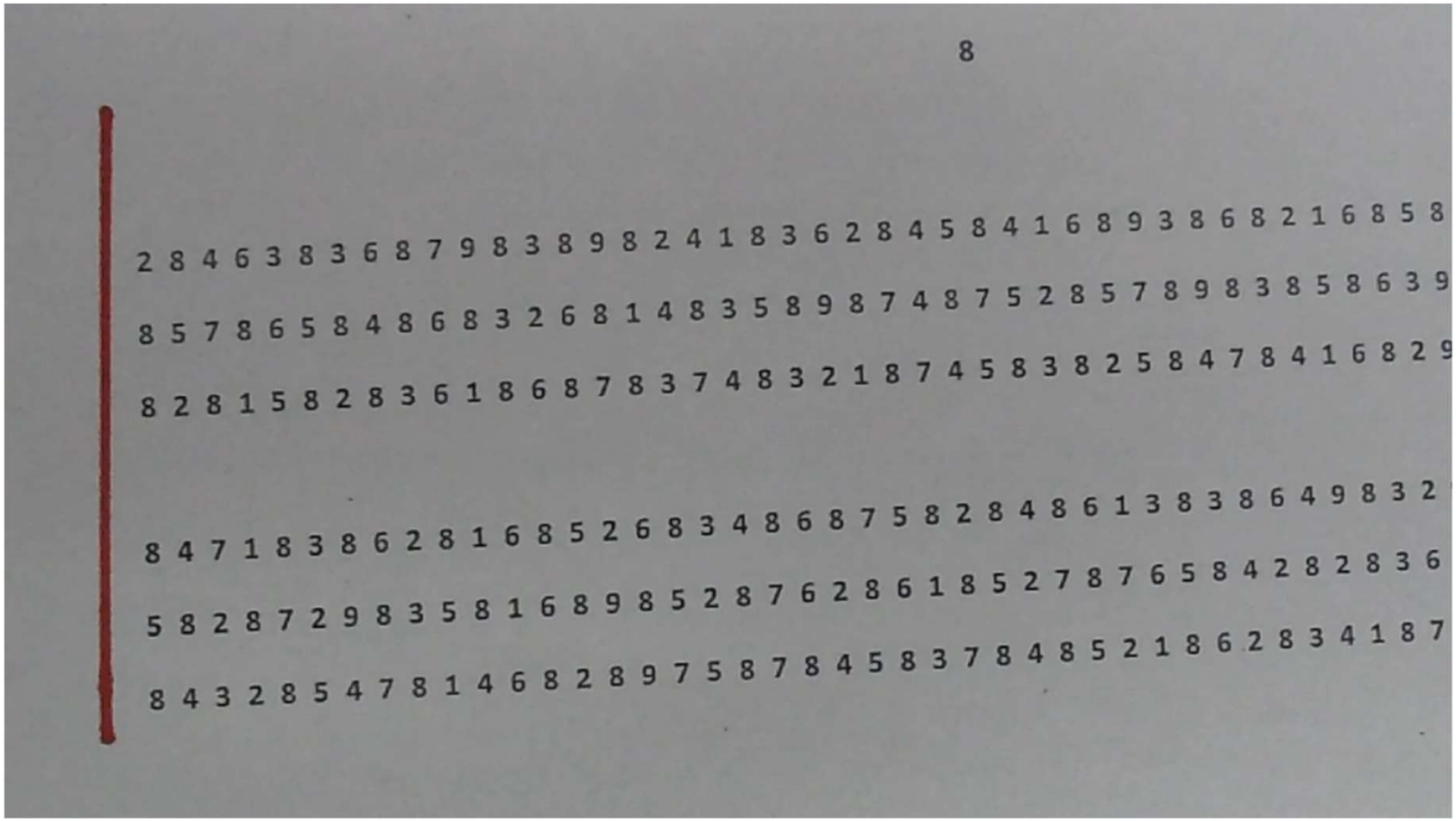
1 stimulus – R cue off



Visual Scanning Training

Systematic/Orderly Sequence

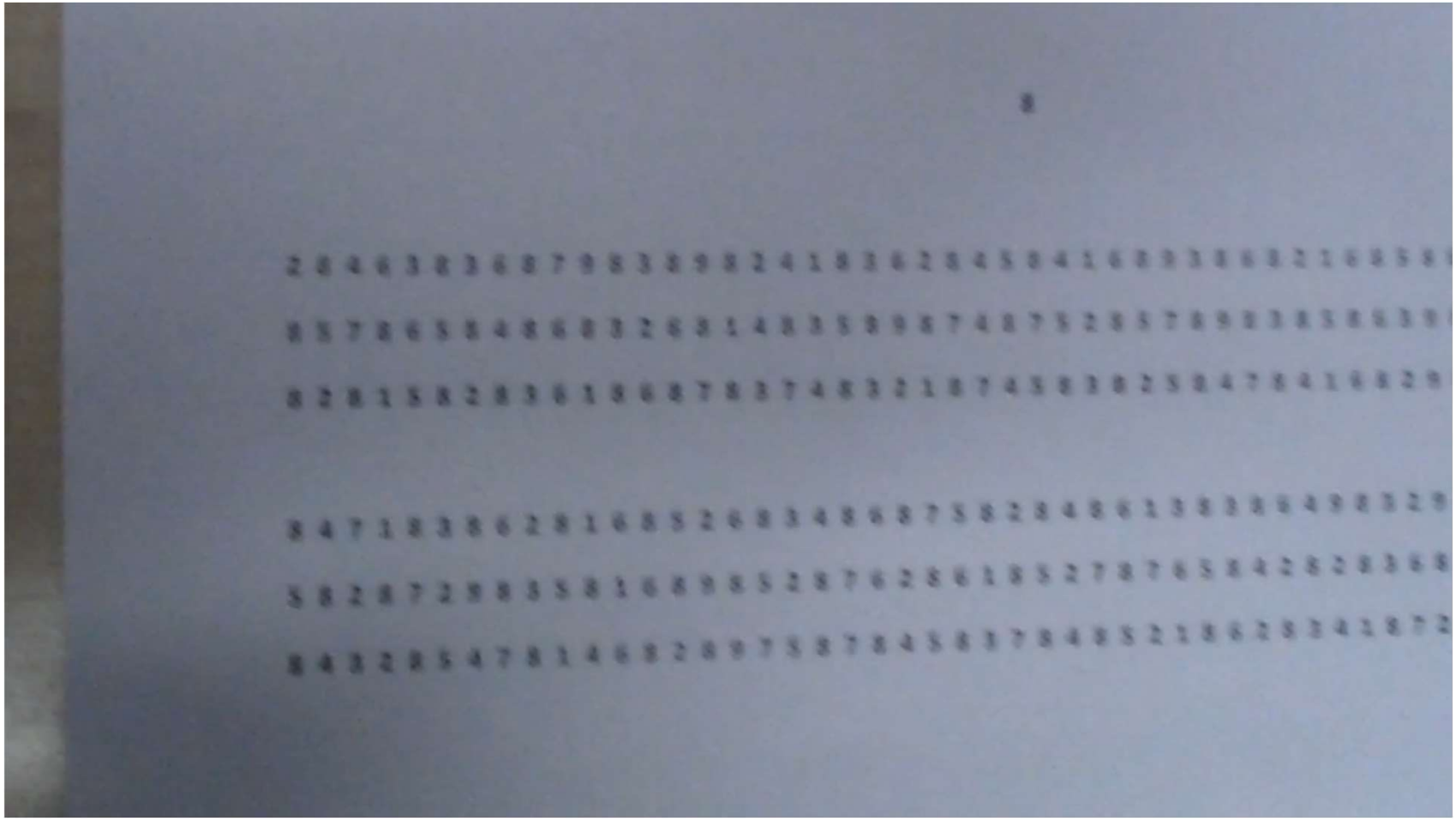
1 stimulus – line only



Visual Scanning Training

Systematic/Orderly Sequence

1 stimulus – no cues



Visual Scanning Training
Systematic/Orderly Sequence

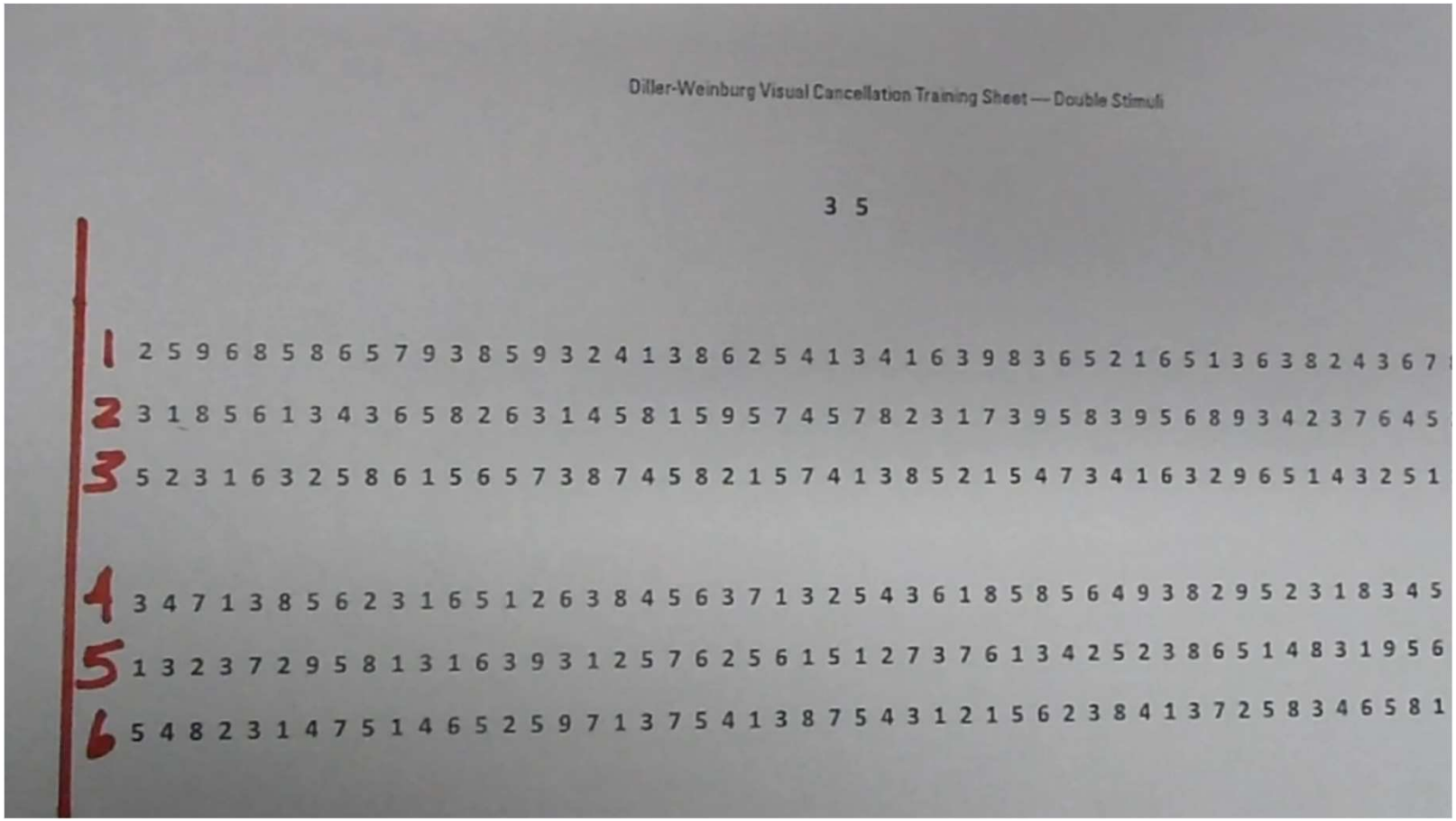
For Double-Stimuli Task: Repeat initial training steps for single-stimulus training task

- Orient patient to left anchor line, and # 1 next to line
- Ask patient to scan from left to right along first line
- Observe/correct for any “3s” or “5s” skipped, or any numbers misread/omitted
- Ask patient to scan back to left to start next line:
  - Note number at end of line
  - Scan visually to left
  - Find anchor line
  - Use numbers to orient to beginning of next line
- Criteria: Same as for single-stimulus task

Visual Scanning Training

Systematic/Orderly Sequence

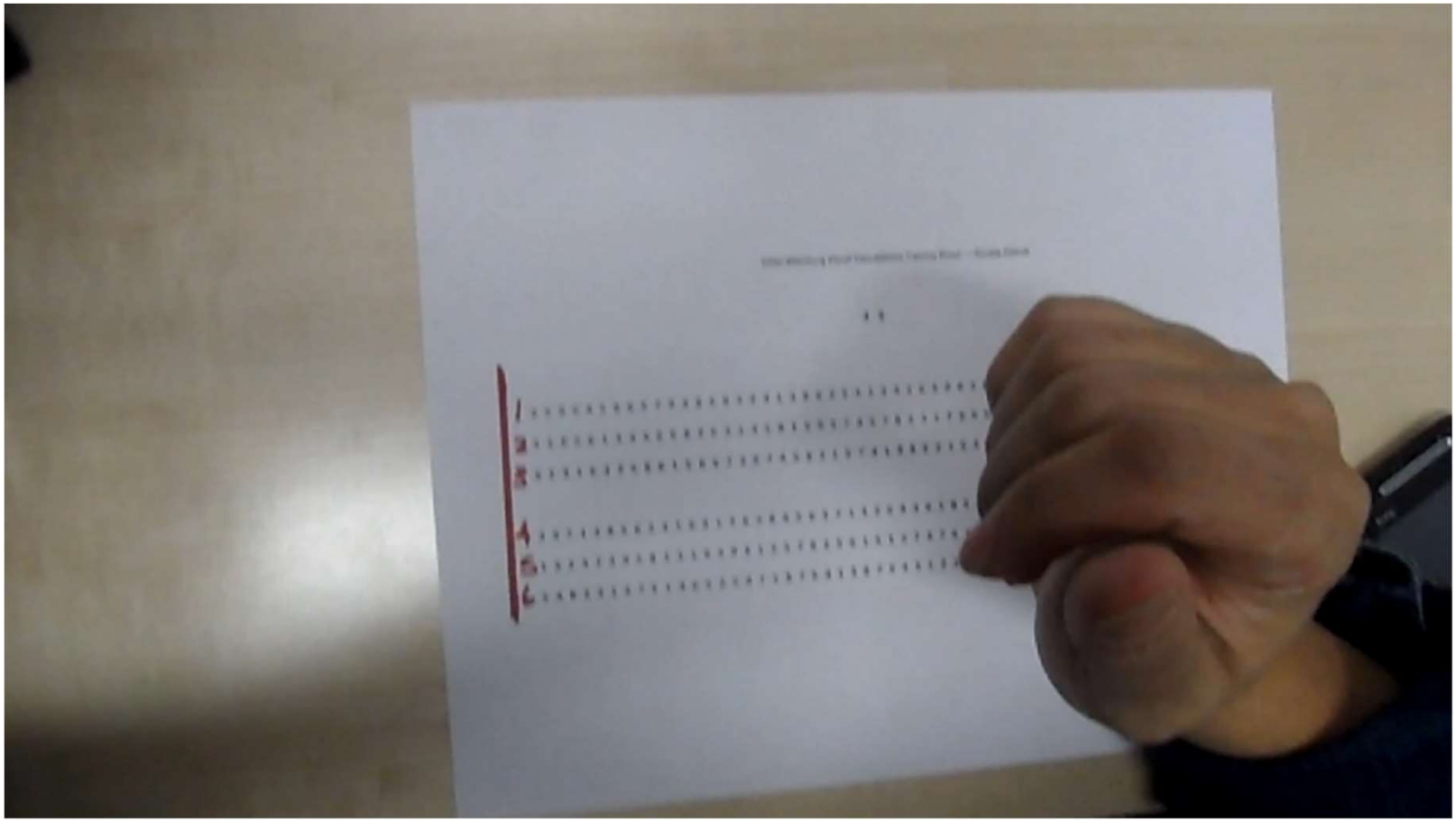
2 stimuli – all cues



Visual Scanning Training

Systematic/Orderly Sequence

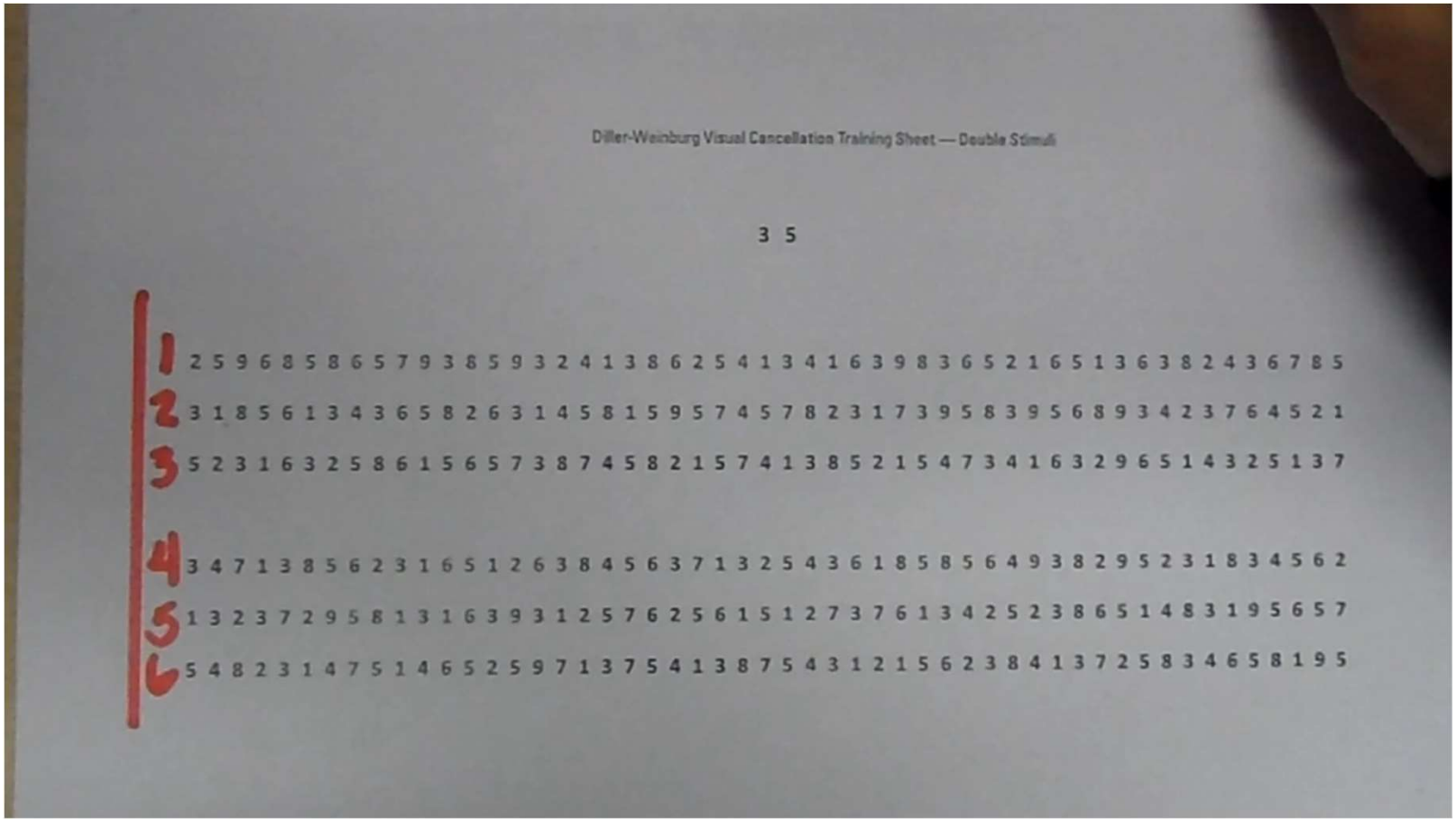
2 stimuli – R cue off



Visual Scanning Training

Systematic/Orderly Sequence

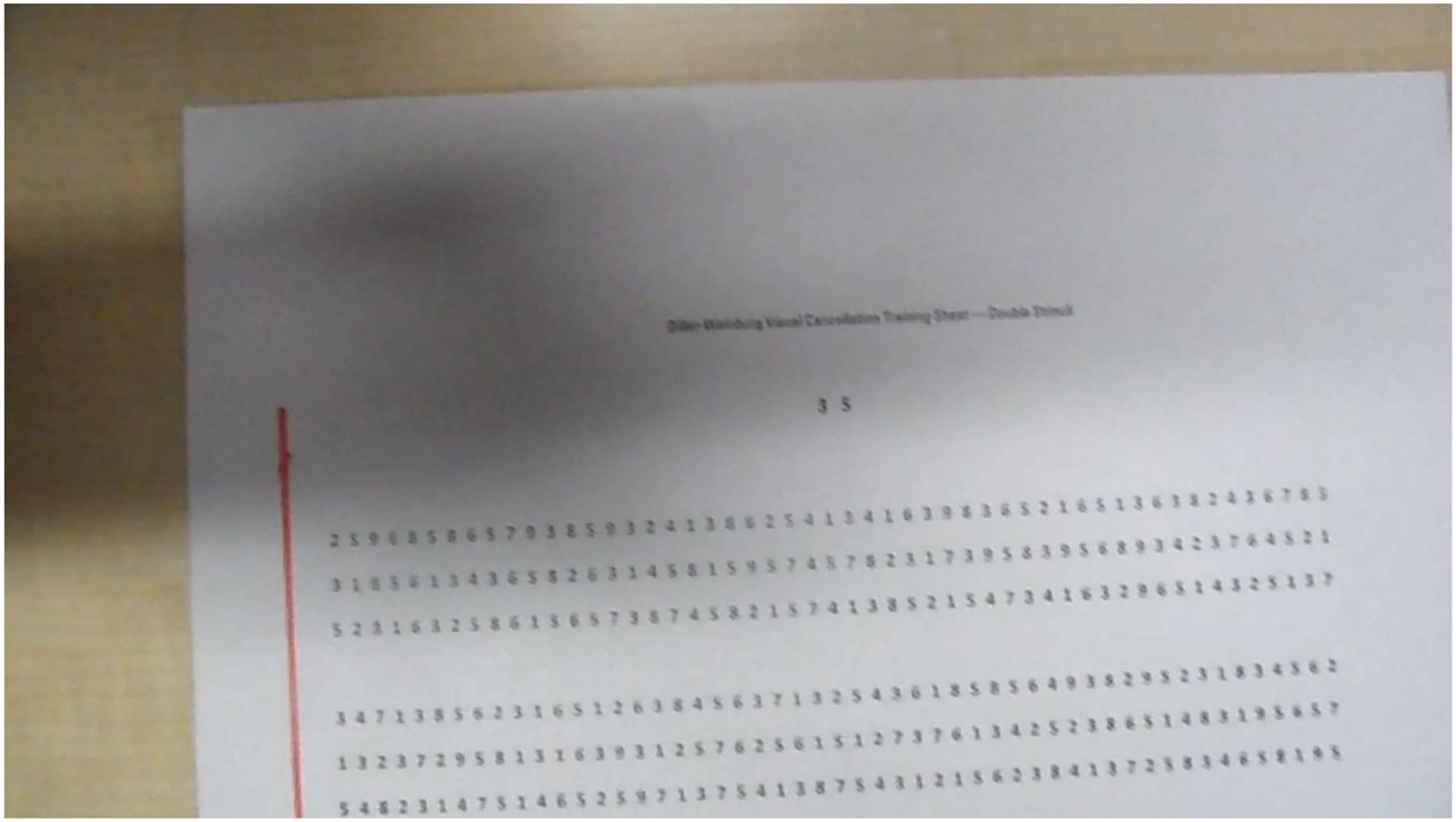
2 stimuli – R cue off 2



Visual Scanning Training

Systematic/Orderly Sequence

2 stimuli – line only



Visual Scanning Training
Copying / Drawing Line Drawings

Pizzamiglio et al., 1992

- Case series with 13 subjects
- Training:
  - 40 sessions of
    - visual scanning (computerized, large screen)
    - various stimuli (pictures, faces, words, calculations),
    - reading & copying,
    - copying line drawings, and figure descriptions

Results:

- Improvement on standard tests of neglect
- Improvement of scanning in real life

Visual Scanning Training
Copying Text and Writing

1. **Establish patient understanding of problem**
   - To improve basic scanning ability
   - To improve accuracy of copying or writing
   - To decrease impulsivity

2. **Gather and prepare materials**
   - Samples of text, starting with simple sentences
   - Page for copying/writing text
   - Tape page to flat working surface, if needed
   - Add needed cuing structure

Visual Scanning Training
Copying Text and Writing

3. Training Steps:

- Draw vertical line on left to *anchor* left field on both text and copying page; write in numbers on left and right
- Orient patient to left anchor lines, and #1s next to lines
- Ask patient to scan from left to right along first line of text
- Ask patient to read *aloud* one word at a time, line-by-line
- Ask patient to copy one word at a time, line-by-line
- Use *anchor* lines/numbers to guide patient from text to copy space:
  - Note numbers at beginning/end of line in text to be copied
  - Find anchor line in copy space and number corresponding with text line
  - Use anchor line/numbers to orient to beginning of each line
- Observe patient and correct if patient:
  - Misreads/omits any word while reading or writing

Visual Scanning Training
Copying / Drawing Line Drawings

Copying Line Drawings (Pizzamiglio et al., 1992)

1. Establish patient understanding of problem
   - To improve basic scanning ability
   - To improve accuracy of drawing
   - To decrease impulsivity
2. Gather and prepare materials
   - Two pages of dot-matrices (2-dots X 2-dots)
     - Matrix on left has line connecting top two dots
     - Matrix on right has dots only
   - Tape page to flat working surface, if needed
   - Add needed cuing structure

Visual Scanning Training
Copying / Drawing Line Drawings

3. Steps in copying line drawings (cont'd):

- Visual Anchors
  - Provide vertical *anchor* on left-side of both stimulus and copy-space matrix
  - Provide numbers on left and right side of each horizontal row of dots on both sheets, as needed
  - Place small circle at starting point of line on both sheets
- Verbal Anchors
  - Provide verbal cuing similar to copying text, encouraging verbalization and use of both horizontal anchors and sequential numbering
- Gradually increase number of dots in matrix up to 20

Visual Scanning Training

Copying / Drawing Line Drawings

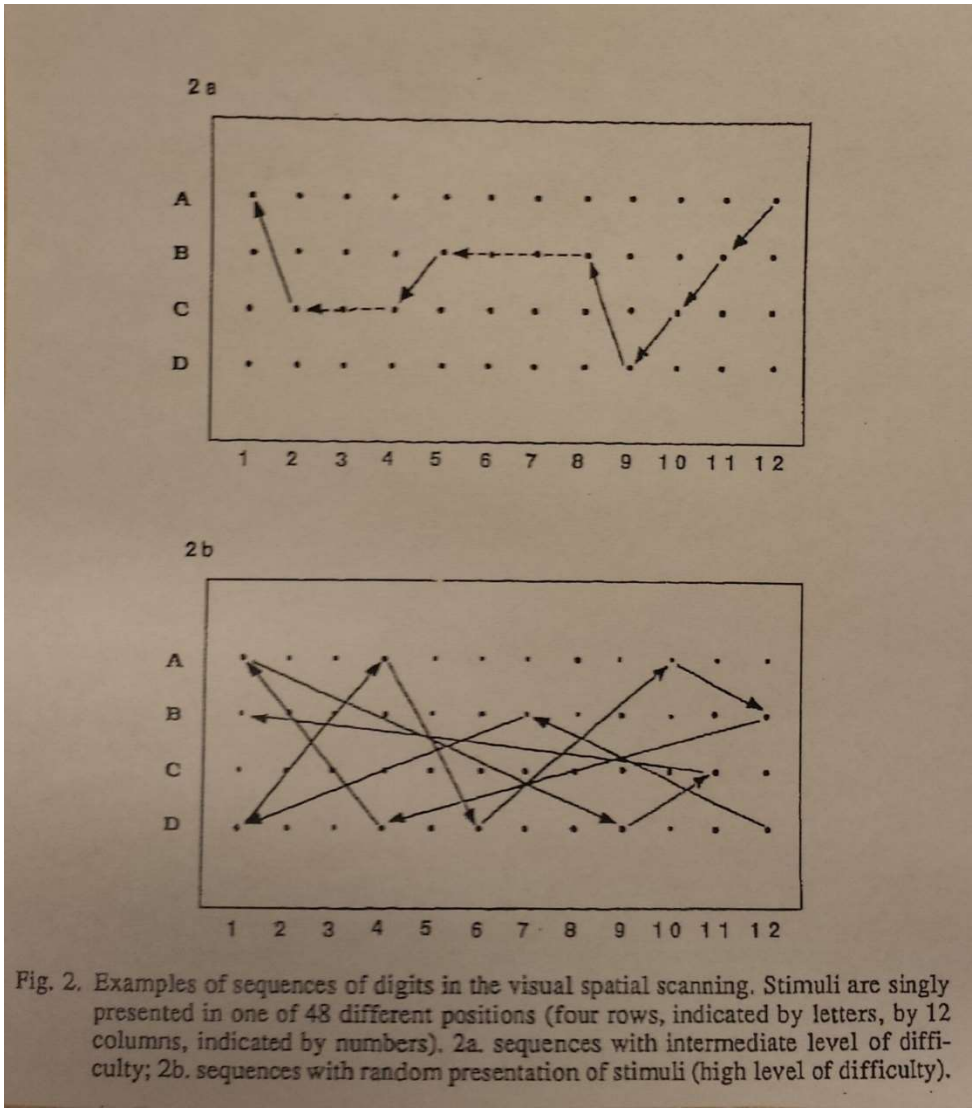


Fig. 2. Examples of sequences of digits in the visual spatial scanning. Stimuli are singly presented in one of 48 different positions (four rows, indicated by letters, by 12 columns, indicated by numbers). 2a. sequences with intermediate level of difficulty; 2b. sequences with random presentation of stimuli (high level of difficulty).

Other scanning tools

- Dynavision
- Apps
- Other?

NB:
Little data to evaluate efficacy.

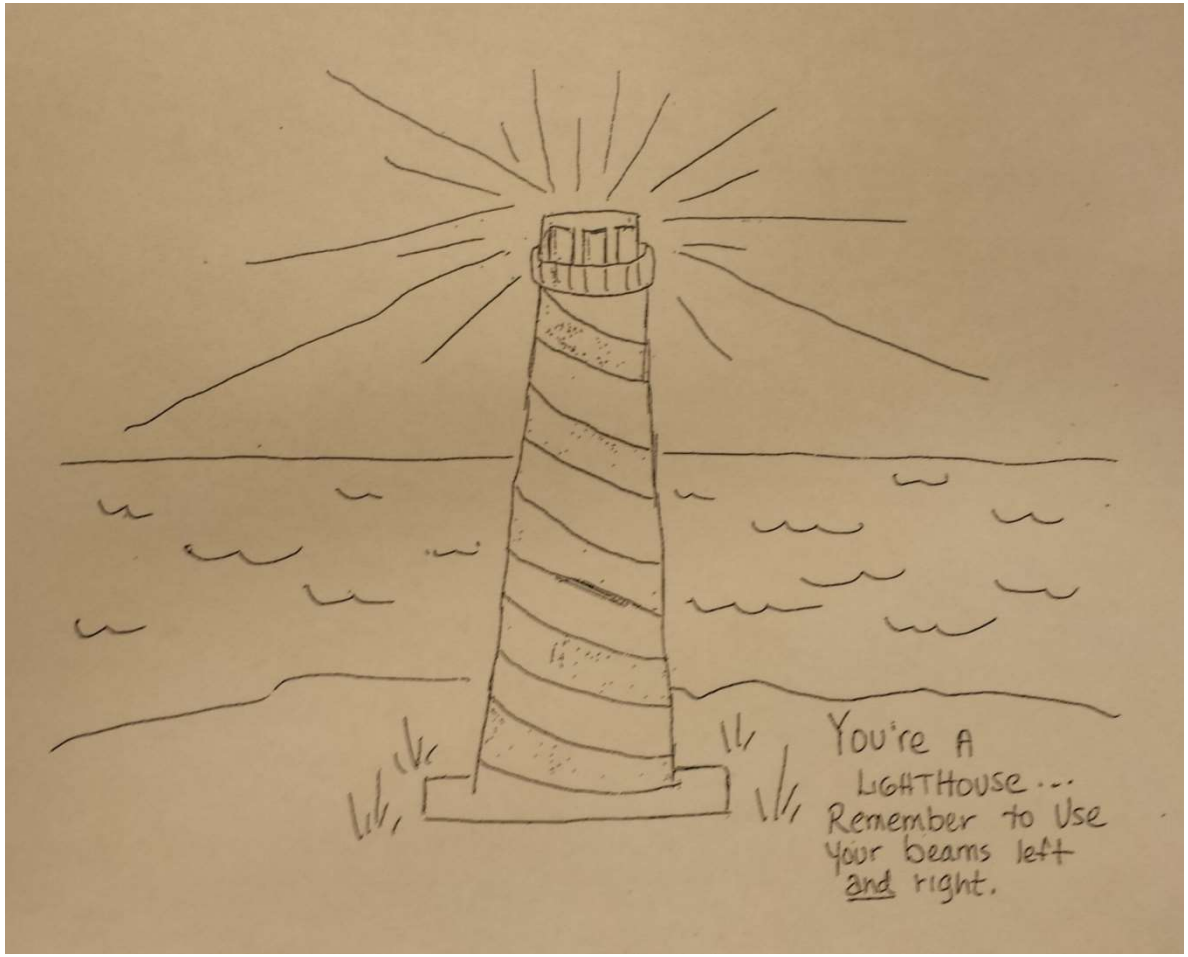
Recommend if using, to use only after or in conjunction with VST.

Use principles established by Diller et al. (1980), & Pizzamiglio et al. (1992).

Top-down Methods: Lighthouse Strategy

Visual Scanning Training

Lighthouse Strategy (Niemeier, 1998)



Visual Scanning Training

Lighthouse Strategy (Niemeier, 1998)

Niemeier, 1998

- 16 subjects compared with matched controls
- Trained to use the “Lighthouse Strategy” (LS) in paper/pencil tasks, other table-top tasks, and walking through rehabilitation facility
- Instructions place throughout facility and at home

Results:

- Improvement on paper/pencil visual scanning tasks
- Reported safety improvement – rehab & home

Visual Scanning Training
Lighthouse Strategy (Niemeier, 1998)

- When engaging in task:
  - Patient asked to imagine that s/he is a lighthouse (eyes like lights sweeping left to right)
  - Patient shown picture of lighthouse
  - Picture then placed on patient's left
- Therapist asks: "What would happen to ships if lighthouse lit only on the right side of the ocean and horizon?"
- Table-top visual stimuli presented, width gradually increased
- Therapist provides visual/verbal cuing, as well as feedback
- After table-top visual stimuli, environmental stimuli introduced
- Physical and verbal cues gradually faded

Top-down Methods: Self-instruction Training

O'Callaghan, 1998

Table I. Problem-Solving Scripts for the

First Wheelchair Navigation Script

1. If I have a problem getting from point A to point B, I should stop after 2 attempts.
2. Then I should push myself away to figure out what the problem is.
3. Then I should figure out the possible solutions to the problem.
4. Next I should analyze the solutions.
5. Then I figure out the best solution.
6. Then I implement the solution.
7. Then ask myself if it worked. If it did not, then start the problem-solving process all over again.

Modified Wheelchair Navigation Script

Stop. What is the problem? Think how to do it.
Choose a new angle. Scan to the left. Did it work?

Yes	*No*
Pat yourself on the back. I did a good job. I took my time. I figured out the solution.	Analyze the situation Stop. Think how to do it differently. If I get frustrated, count to 11. Think how to do it differently. Go ahead.

Pre-training: Got ‘stuck’, 10+ times/week.
Post-training: Got ‘stuck’, ~ 1/week.

Top-down Methods: Mental Imagery

Visuomotor imagery as a new tool in the rehabilitation of neglect: a randomised controlled study of feasibility and efficacy

Welfringer et al., 2011, *Disability & Rehabilitation*

- Randomized controlled trial
- 30 participants
- Imagery was a supplement to standard therapy
- 12/15 participants receiving imagery training spontaneously reported improvements with 9 of these rating therapy as ‘highly beneficial’
- Mixed results on other measures

Before every session:

"Try to explore and visualize the left side of your body and perceive it as intense as possible. Imagine and sense your left hand, feel the underground it is lying on. Try to feel every single finger. Be aware of tensions and try to re ax your left hand and fingers. Now try to feel your forearm, sense its' position and let your thoughts wander over the e bow to the upper arm. Try to feel how your muscles relax. Let your thoughts wander over the shoulder and your neck. Try to be conscious of your left arm. All your thoughts are drifting into your body. Leave all distractions behind. Imagine yourself being in a warm and relaxing place."

Example for imagined everyday life sequence:

"Try to imagine how your left hand grasps the apple lying in front of you. You extend your left arm. the elbow straightens. Feel the muscle tension in your arm. Feel how the fingers press around the apple and hold it. Wove the apple to your mouth. Feel how the elbow is moving and the forearm is getting up towards your mouth. Feel the rotation in your elbow. Feel the muscle tension in your forearm and the upper arm needed to hold your arm. Your arm feels heavy. Feel the tension in the hand and the fingers so that the apple won't fall. Hold your arm strongly in this position for a moment."

"Now move your arm back to the table. The fingers release the apple. Feel the relaxation in the fingers. The muscles of your hand, your forearm and your upper arm are relaxed. The hand rests on the table, the apple lays in front of you again."

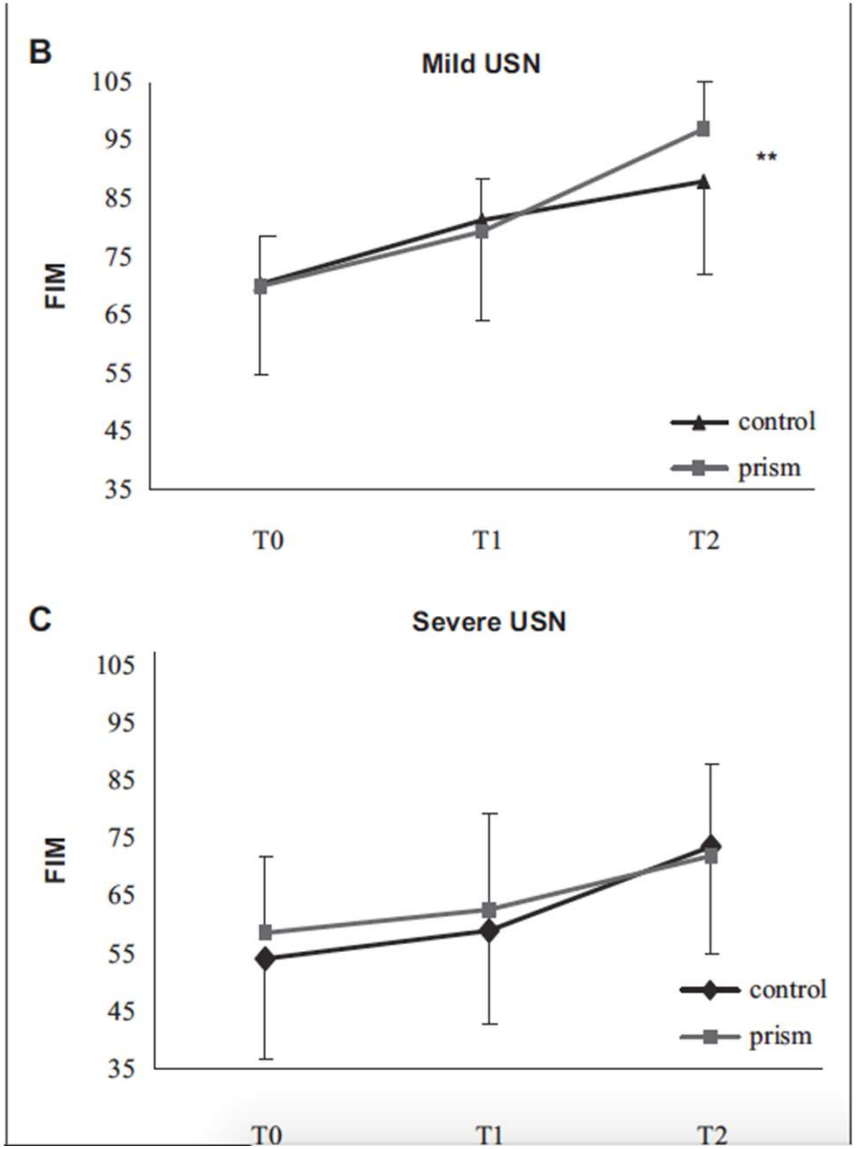
Imagined Limb Activation
McCarthy et al. (2002)

- **Two single-case studies – performing motor exercises prior to paper/pencil tasks:**
  - **Perform exercises with right hand**
  - **Imagine exercises with right hand / left hand**
  - **Results:**
    1) **1st patient showed decrease in neglect behavior on tasks following imagined left-hand activation**
    2) **2nd patient showed increase in neglect behavior on tasks following imagined right-hand activation**

Bottom-Up Approaches
Prism Adaptation

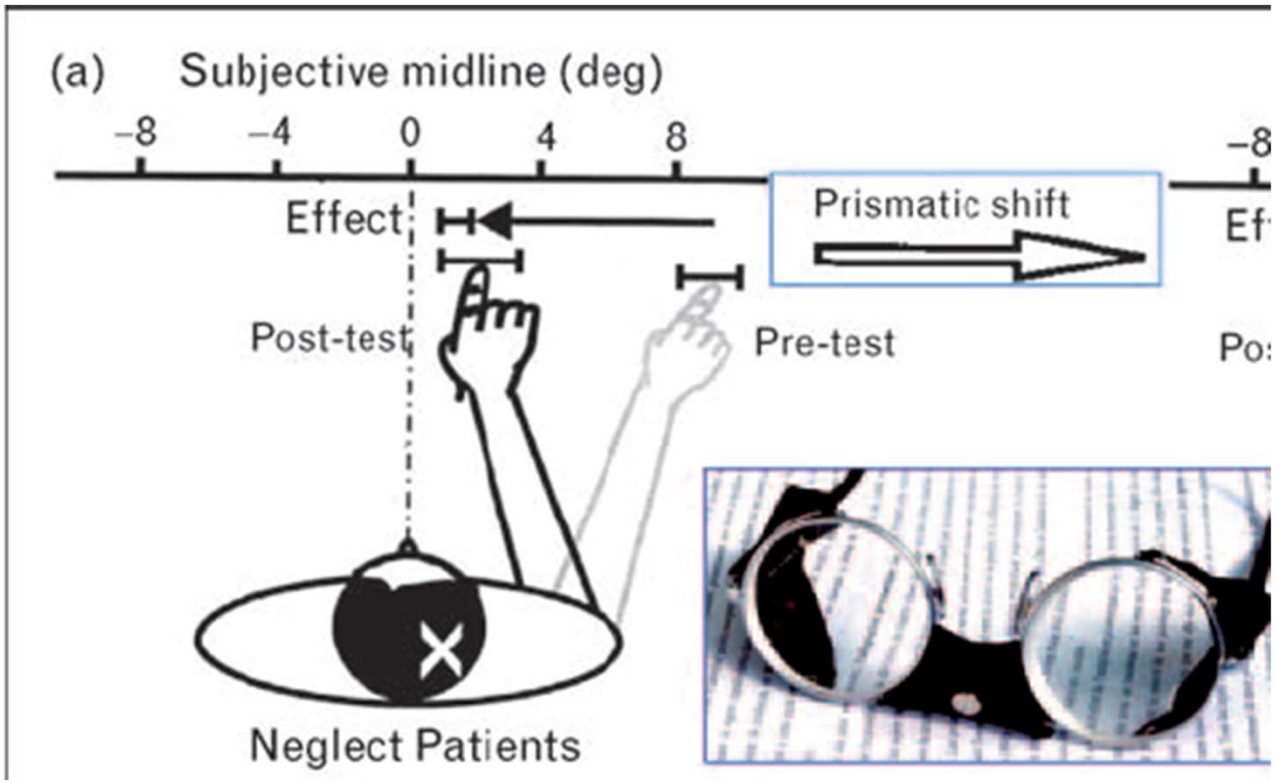
Prism Adaptation

- Manipulation of the sensory environment
- Mizuno et al. (2013) *Neurorehabilitation & Neural Repair* – RCT – n=38



Prism Adaptation

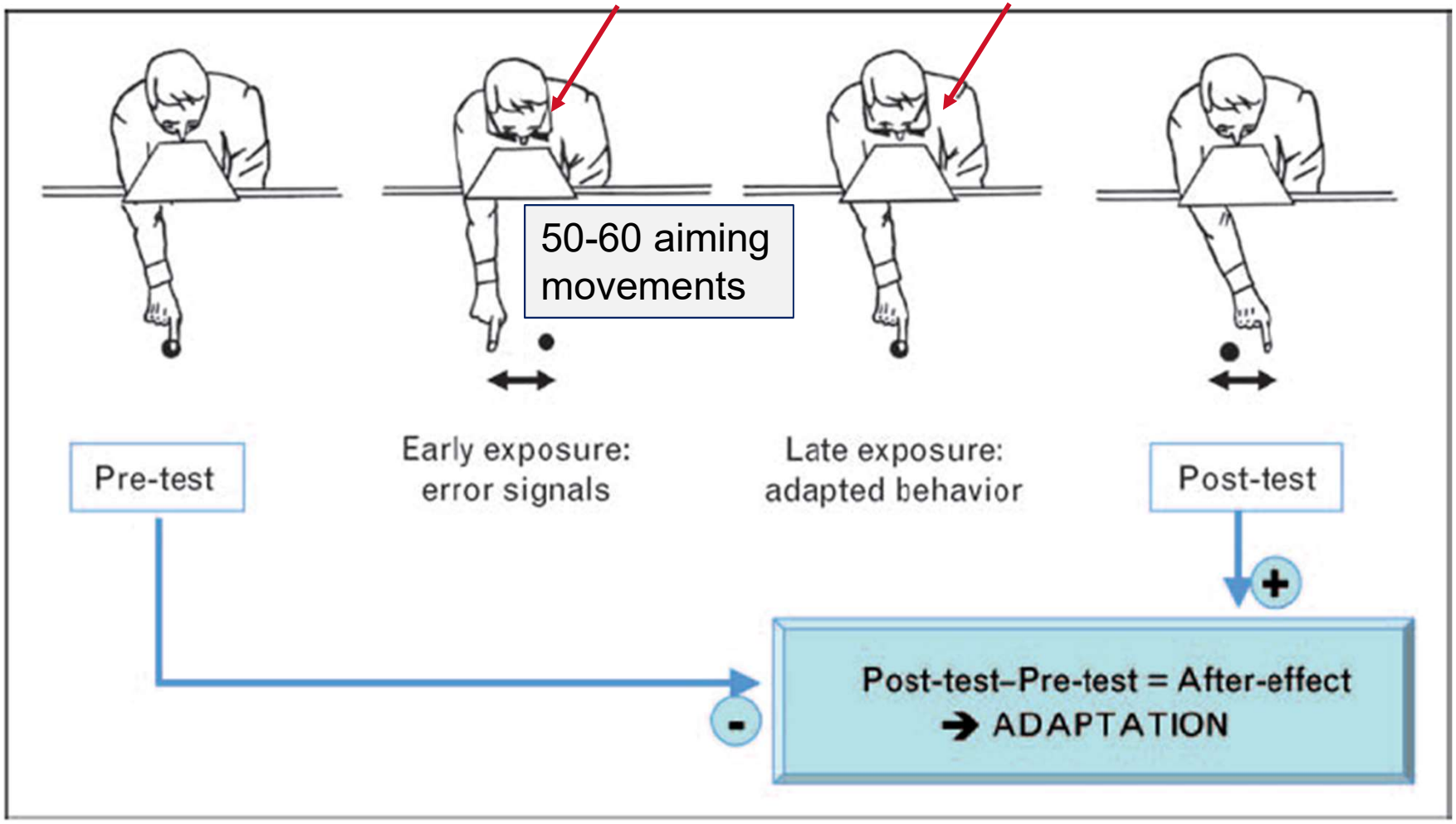
- Manipulation of the sensory environment



Pisella et al., 2006, *Curr Opi Neurol*

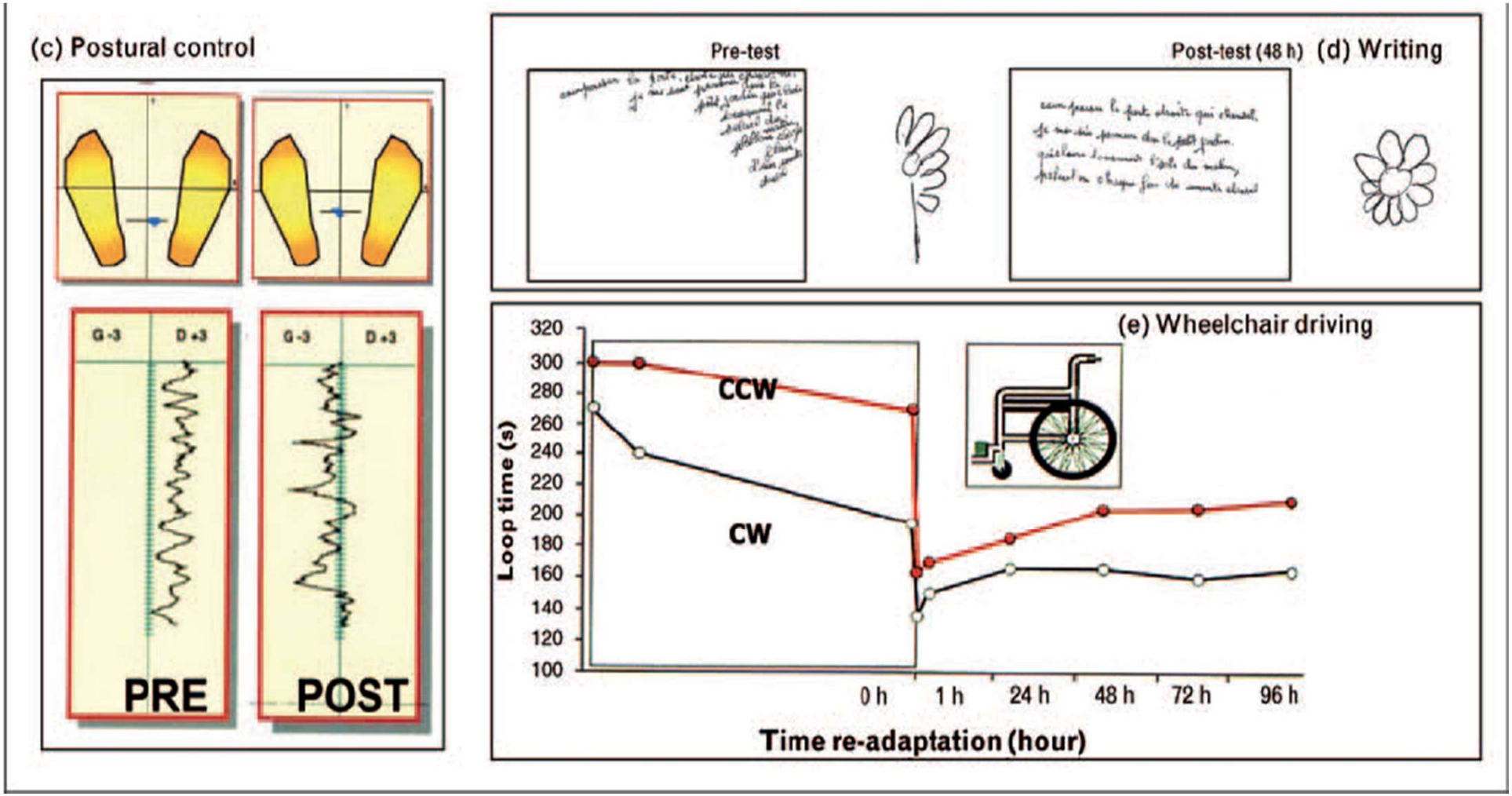
Prism Adaptation

https://www.youtube.com/watch?v=DvlCWTXh12E



Pisella et al., 2006, *Curr Opi Neurol*

Prism Adaptation



Pisella et al., 2006, *Curr Opi Neurol*

Sample Protocol using Prisms

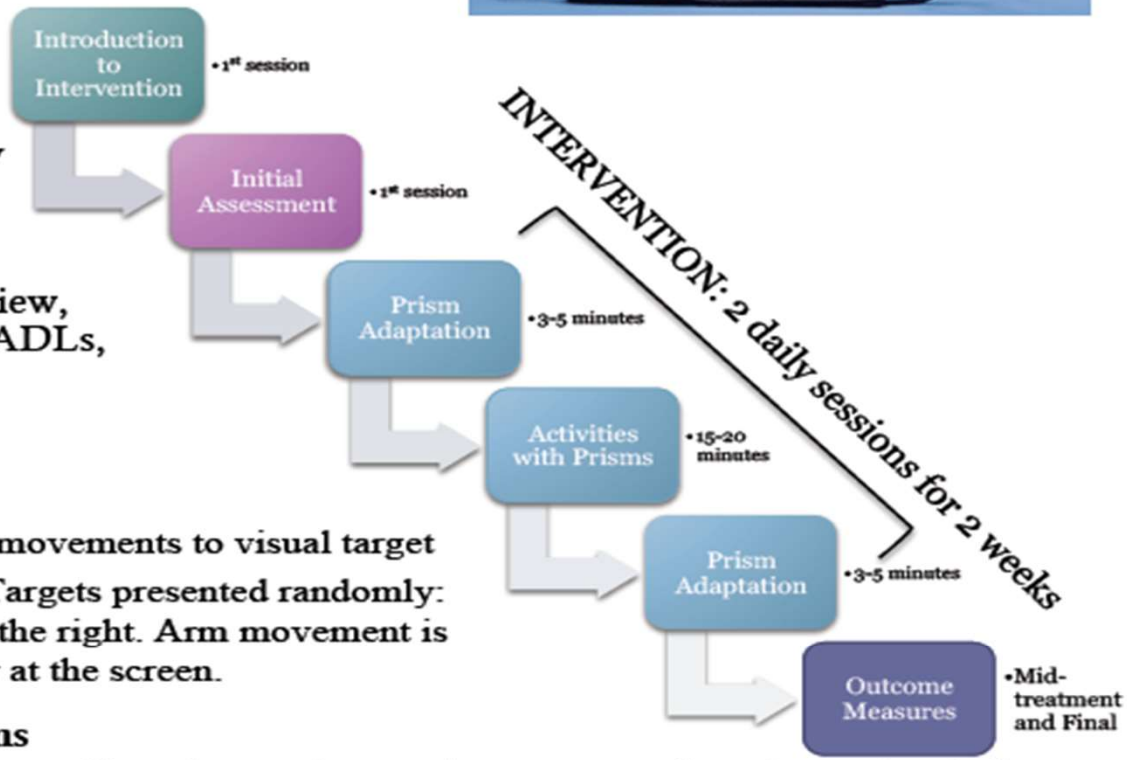
First session:

Introduction to Intervention

Share information with client about inattention, prisms, how prism therapy works, including evidence.

Initial Assessment

Should include: semi-structured interview, observations of client participating in ADLs, line bisection/cancellation tests.



Intervention:

3-5 minutes of prism adaptation

15° rightward shift prisms, 90 pointing movements to visual target on a screen 60cm from clients midline. Targets presented randomly: 30 in the centre, 30 to the left, and 30 to the right. Arm movement is occluded, so client may only view finger at the screen.

15-20 minutes of activities with prisms

Participate in following activities using unaffected arm: ring tossing game, pegboard exercise, ball throwing to target, play cards, serve a cup of tea. Choose activities that are meaningful to client and vary activities each session. Using meaningful occupations increases client's agreeability to the intervention.

Follow with 3-5 more minutes of prism adaptation with visual targets.

Alves, Ashley, Authors, Beck, Fong, Halyk, McDonald & Pham, Unpublished

Combined Approaches Limb Activation in Visual Scanning Training

Hemispatial Neglect
Evidence-Based Recommendation

Practice Option

- Inclusion of limb activation or electronic technologies for visual scanning training may be included in the treating of neglect after right hemisphere stroke

Evidence for Benefit: Limb Activation

- also see Azouvi et al. (2017) *Ann Phys Rehabil Med* (systematic review)
- Searching for left cue – e.g., arm – is the endogenous or top-down part
- Involve active or passive movements of hemiparetic limb provides sensory input and is the bottom-up part of approach – can be supplemented with auditory input
- Movements must be in contra-lesional space

Limb Activation Approaches

- **Encourage left-sided movement before or during visual training tasks** (Brunila et al., 2002; Samuel et al., 2000; Wilson et al., 2000; Worthington, 1996)
  - Tap the table as much as possible before beginning task
  - Open and close left hand repeatedly or lift left shoulder during task
  - Utilize scanning and limb activation simultaneously
    - Place left hand at left margin while scanning **"scan to your hand"**
    - Look at left hand; scan across page

Generalization Process

- **Acquisition: Psycho-education and task orientation.**
- **Application: Learning of procedures and strategies.**
  - **Anchoring**
  - **Pacing**
  - **Managing density and complexity**
  - **Checking and feedback**
- **Adaptation: Internalization of structured approach; practice with principles in more everyday tasks:**
  - **----reading, shopping, movies, traveling**

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