UNILATERAL-SPATIAL INATTENTION

ICBO CONGRESS
POMONA. CA
APRIL 8, 2010

ROBERT B. SANET, O.D., F.C.O.V.D.
San Diego Center for Vision Care
7898 Broadway
Lemon Grove CA 91945
rsanet@cs.com
UNILATERAL SPATIAL INATTENTION (NEGLECT)

GENERAL CHARACTERISTICS
UNILATERAL SPATIAL INATTENTION (NEGLECT)

- Many Names: Unilaterial Spatial Neglect, Hemi-Neglect, Unilateral Spatial Inattention

- Involuntary failure, or reduced ability to attend or respond to meaningful sensory stimuli presented in the affected hemi-field

- As opposed to a hemianopsia, it is not caused by a defect in the Geniculostriate pathway

- May or may not be accompanied by hemiplegia and homonymous hemianopsia
UNILATERAL SPATIAL INATTENTION (NEGLECT)

- Usually the result of a right parietal lobe lesion, but it can occur as a result of damage in many other areas of the cortex.

- Stroke is the most common cause.

- Mechanism is not totally clear.

- May affect Personal Space (body image), Peri-Personal Space (within arms reach) or Extra Personal Space (outside of arms reach).

- Neglect may be complete or relative-stimulus/intensity dependant.
UNILATERAL SPATIAL INATTENTION (NEGLECT)

- Competitive process

- Sometimes may only occur with simultaneous presentation (extinction phenomenon)

- May present with any combination of visual, auditory or tactile stimuli

- More devastating, but also more remediable than a visual field defect

- The presence of neglect more than 3 months post stroke is a major predictor of Activities for Daily Living (ADL) abilities
UNILATERAL SPATIAL INATTENTION (NEGLECT)

PREDICTOR OF TREATEMENT OUTCOMES
VISUAL-SPATIAL INATTENTION AND ACTIVITIES FOR DAILY LIVING (ADL)

- Conducted at the School of Occupational Therapy, Hebrew University of Jerusalem, Israel
- Objective was to evaluate the impact of unilateral spatial neglect (USN) on the rehabilitation outcome and long-term functioning in activities of daily living (ADL) in right hemisphere damaged stroke patients
- Assessed sensory-motor and cognitive impairment and functional disability upon admission to rehabilitation, upon discharge from rehabilitation hospital and 6 months after discharge
VISUAL-SPATIAL INATTENTION AND ACTIVITIES FOR DAILY LIVING (ADL)

Results:

- Neglect is associated with lower performance on measures of impairment (sensory-motor and cognitive), as well as on measures of disability in ADL.

- Differences were significant in all testing periods admission, discharge, and 6 months post discharge.

- The recovery pattern for patients with USN is slower and more attenuated.

- USN is the major predictor of rehabilitation outcome from admission to follow-up.
UNILATERAL SPATIAL INATTENTION (NEGLECT)

PROPOSED MECHANISMS
UNILATERAL SPATIAL INATTENTION (NEGLECT)

Vallar & Perani, 1986

- Considerable evidence that damage to the inferior parietal lobule (IPL), more than any other brain region, produces the classic symptoms of neglect.

- Region of the IPL appears to be at the apex of a multistage cortical processing stream.

- IPL receives inputs from subcortical structures that carry ocularmotor and attentional signals.
UNILATERAL SPATIAL INATTENTION (NEGLECT)

Vallar & Perani, 1986

- IPL integrates somatic, visual, and movement information
- IPL appears to be one of the primary cortical regions governing attention
- The IPL is thought to be part of the ventral stream
UNILATERAL SPATIAL INATTENTION (NEGLECT)

Milner and Goodale, 1995:

- Superior parietal lobe is part of dorsal stream which mediates control of goal directed actions

- Lesions restricted to the superior parietal lobe lead to disturbances in visuomotor control (optic ataxia)

- Lesions of the inferior parietal lobe lead to spatial neglect

- Due to damage to areas which deals with abstract spatial reasoning, based on input from the ventral stream which permits the formation of perceptual and cognitive representations which embody the enduring characteristics of objects and their significance
Perenin, 1997:

- Superior part of the parietal cortex is involved with direct coding of space for action

- Inferior part or parietal lobe is responsible for more enduring and conscious representations underlying spatial cognition and awareness
Karnath, 1997:

- The brain uses inputs from various afferent channels to elaborate a unitary representation of egocentric space.
- Neglect due to an altered representation of body-centered space.
- In neglect, the coordinate transformation has a systematic error that results in deviation of the spatial reference to the ipsilateral side.
UNILATERAL SPATIAL INATTENTION (NEGLECT)

Kinsbourne, 1987:

- Orientation is not intact in either right or left hemispace
- A lateral gradient of attention sweeps across both hemispheres
- There is a gradient of severity of the neglect across the entire visual field
UNILATERAL SPATIAL INATTENTION (NEGLECT)

Rizzolatti and Berti, 1990:

- Neglect results from a lesion in higher order spatial maps
- There is gradient of severity across the visual field with a maximum severity in the extreme contralateral hemifield to a minimum severity in the extreme ipsilateral field
UNILATERAL SPATIAL INATTENTION (NEGLECT)

Summary of Research:

- Many varied presentations of USI depending on the specific brain area(s) involved

- Inferior parietal lobule (IPL), more than any other brain region, produces the classic symptoms of neglect. However, it must be remembered that many different cortical areas may produce neglect

- May present as problems with various functions and areas of space
  - Body image
  - Visuo-motor control
  - Cognition
  - Attention

- USI appears to manifest as a biased gradient of attention across the entire visual field
UNILATERAL SPATIAL INATTENTION (NEGLIGENCE)

EVALUATION
UNILATERAL SPATIAL INATTENTION (NEGLECT)

Visual Field Defect-No Neglect-???
UNILATERAL SPATIAL INATTENTION (NEGLECT)

Visual Field Defect-???  Neglect???  Both???
OPTOMETRIC EVALUATION
OF
THE ABI PATIENT WITH VISUAL SPATIAL NEGLECT

PROBES:

- Questions to patient/caregiver regarding behavior
- Patient’s awareness of problem
- Observe Behavior
- Drawing tests: Clock, Flowers, etc.
- Scanning Tests
- Line Bisection Cross Out Task (Suter analysis)
- Two Penlights-Extinction
- Read Hart Chart
- Auditory/tactile stimuli
FIGURE DRAWING TESTS

Copying:

Spontaneous drawing:

(a)

(b)
DRAW A CLOCK
FLOWER COPYING TEST
LINE BISECTION TEST

Neglect patient

Ignored portion of space -
CANCELLATION TESTS
# NAVON FIGURES

Global vs. Local Features

| AAAAAAAA | EEEE  |
| AAAAAAAA | EE    |
| AA       | EE    |
| AAAAAAAA | EEEE  |
| AAAAAAAA | EEEE  |
| AA       | EE    |
| AAAAAAAA | EE    |
| AAAAAAAA | EE    |
| AAAAAAAA | EE    |
| AAAAAAAA | EE    |

| EEEE  |
| EE    |
| EE    |
| EEEE  |
| EEEE  |
| EE    |
| EE    |
| EE    |
| EE    |
LINE BISECTION TEST

Caution!

- Study by Ferber & Karnath, 2001

- Examined validity of a line bisection test and four cancellation tests

- Found that the line bisection test missed 40% of the neglect patients

- Cancellation tests only missed 6% of the subjects

- Deviations in line bisection may be indicative of other conditions, such as hemianopia

- Conclusions: Result calls into question line bisection tests as a valid assessments tool and confirmed the use of cancellation tests
The Line Bisection Cross Out Task (by Suter)

- In deep neglect, the patient will neglect to bisect the lines on one side of the paper.

- In lesser neglect, the patient will bisect all of the lines, but the lines greater than 5 cm in length will be bisected away from the neglected field.

- A patient with a hemianopsia without neglect tends to bisect the line toward the blind field, as if they are aware of the defect and overcompensate in the process.
Line Bisection Cross Out Task

The Line Bisection Cross Out Task (by Suter)

- There is a caveat to the right-left bisection bias… a patient with a hemianopsia plus neglect may bisect the lines accurately

- Do not get out your ruler to score. Healthy normal subjects seem to show a slight bias to left side, so if you score with a ruler, everyone will be a neglect suspect

- If truly present, the differences should be easily discerned by “eyeballing” the sheet
GRADIENT OF NEGLECT
UNILATERAL SPATIAL INATTENTION (NEGLECT)

TREATMENT

Fig 1. The hemispatial sunglasses worn by the patients in the study.
TREATMENT OPTIONS
FOR
UNILATERAL SPATIAL INATTENTION

- Vestibular Stimulation
- Hemi-Spatial Sun Rx
- Yoked Prisms
- Optokinetic Stimulation
TREATMENT OPTIONS
FOR
VISUAL-SPATIAL INATTENTION

VESTIBULAR TREATMENT
TREATMENT OPTIONS FOR VISUAL-SPATIAL INATTENTION

VESTIBULAR TREATMENT

- Neglect temporarily improved by caloric stimulation, neck vibration and optokinetic stimulation, but effects are transitory-lasting no more than 10-12 minutes.
TREATMENT OPTIONS FOR VISUAL-SPATIAL INATTENTION

HEMI-SPATIAL SUNGLASSES
TREATMENT OPTIONS FOR VISUAL-SPATIAL INATTENTION

HEMI-SPATIAL SUNGLASSES

Study by Arai, Ohi, et. al 1997

- 10 patients with unilateral left neglect
- Used copying and line bisection tasks
TREATMENT OPTIONS FOR VISUAL-SPATIAL INATTENTION

HEMI-SPATIAL SUNGLASSES

Study by Arai, Ohi, et. al 1997

- Used Hemi-Spatial Sun Rx
- Using spectrometer:
  90% light penetration in the unshaded half
  08% light penetration in the shaded half
TREATMENT OPTIONS FOR VISUAL-SPATIAL INATTENTION

HEMI-SPATIAL SUNGLASSES

Study by Arai, Ohi, et. al 1997

- 4 out of 10 patients showed some improvement

- One patient demonstrated dramatic and lasting improvement in functional activities
TREATMENT OPTIONS FOR VISUAL-SPATIAL INATTENTION

YOKED PRISM (PRISM ADAPTATION)
TREATMENT OPTIONS FOR VISUAL-SPATIAL INATTENTION

YOKED PRISM (PRISM ADAPTATION) TREATMENT

Study by Rossetti, et. al 1998

- 12 patients with right brain damage, mean age 62 years
- All in neuro rehabilitation hospital for moderate to severe hemiplegia and somatosensory dysfunction secondary to stroke
TREATMENT OPTIONS FOR VISUAL-SPATIAL INATTENTION

YOKED PRISM (PRISM ADAPTATION) TREATMENT

Study by Rossetti, et. al 1998

- Study took place 3 weeks->14 months post stroke (average 9 weeks)
- Used 10 degree (18 prism diopter) Base Left prisms
- Performed simple pointing task
YOKED PRISM (PRISM ADAPTATION) FOR VISUAL-SPATIAL INATTENTION

For neglect patients:
- Pre-test shows a large effect on the side opposite to the neglect.
- Post-test shows a decrease in the effect, indicating adaptation.

For normal controls:
- Pre-test shows a small effect.
- Post-test shows no significant change, indicating no adaptation.
YOKED PRISM (PRISM ADAPTATION) FOR VISUAL-SPATIAL INATTENTION
YOKED PRISM (PRISM ADAPTATION) FOR VISUAL-SPATIAL INATTENTION

Study by Rossetti, et. al 1998…continued

- In the study, using Yoked Prisms, the positive effect was a minimum of two hours, as compared to other treatments where the effects lasted no more than 10-12 minutes

- Positive effect were found for both sensorimotor and cognitive spatial functions

- “The prisms do not merely act as a passive modifier of sensory afferents (like caloric, vibrational, or optokinetic stimulation), but can be seen as stimulating active processes involved in the plasticity of sensorimotor correspondences by activating brain functions related to multisensory integration and space representation.”
YOKED PRISM (PRISM ADAPTATION) FOR VISUAL-SPATIAL INATTENTION

Study by Rossetti, et. al 1998…continued

Postulated mechanisms to account for the strong improvement in patients with neglect:

- Stimulation of short-term plasticity of brain functions related to spatial transformations and spatial representation may favor the neural restoration of the right hemispheric functions when they have been impaired by a lesion

- Exposure alters the coordinate transformations used by the nervous system to represent extrapersonal space
YOKED PRISM (PRISM ADAPTATION) FOR VISUAL-SPATIAL INATTENTION

Study by Rossetti, et. al 1998…continued

Some conclusions by the authors of the study:

- “The dramatic improvement induced by prism adaptation suggests that a signal is given to the brain that stimulates the recovery process”

- “An attractive aspect of the prism exposure lies in it’s non-invasive nature, acceptability to patients, and ease of use”

- “The duration of the effects, owing to central active process being activated, indicates that this technique may come top have a major role in the neuropsychological rehabilitation of hemispatial neglect.”
YOKED PRISM (PRISM ADAPTATION) FOR VISUAL-SPATIAL INATTENTION

Study by Rossetti, et. al 1998…continued

• Rossetti’s work had been replicated by many researchers, in most cases with similar results:

  - McIntosh, et. al., 2002
  - Farne, et. al., 2002
  - Frassinetti, et. al., 2002
  - Rode, et. al., 2003
  - Luate, et. al., 2006
  - Sumitani, et. al., 2007
  - Seriano, et. al., 2007
UNILATERAL SPATIAL INATTENTION

EXCELLENT REFERENCE ON PRISM ADAPTATION !!!

- Published in Journal of Behavioral Optometry, 2009
- Author: Maura E. Massucci, OD
- Title: Prism Adaptation in the Rehabilitation of Patients with Unilateral Spatial Inattention

Massucci, ME. Prism adaptation in the rehabilitation of patients with unilateral spatial inattention. J Behav Optom 2009; 20:101-105
TREATMENT OPTIONS FOR VISUAL-SPATIAL INATTENTION

OPTOKINETIC STIMULATION
OPTOKINETIC STIMULATION

Study by Kerkhoff, Keller, et. al. 2006

- Published in Restorative Neurology and Neuroscience
- Evaluated pre and post treatment using line bisection tests and cancellation tests in two matched groups
- Transfer was assessed using paragraph reading tests
Study by Kerkhoff, Keller, et., al. 2006

- Performed 5 treatment sessions of repetitive OKN stimulation

- Used the PC based EYEMOVE program: Visual displays of objects all moving coherently toward the neglected side
OPTOKINETIC STIMULATION

Study by Kerkhoff, Keller 2006

- Control group did conventional scanning training
- Found positive in all of the tests administered and transfer to paragraph reading
- Effect from OKN occurred in both high and low velocity movement and with large and small sized displays
Kerkhoff and associates offered two compatible hypothesis for effect of OKN on Neglect

- OKN facilitates the directing of attention toward the neglected regions of space. The improved attention allocation leads to improved exploration of leftward space

- Leftward OKN facilitates more accurate egocentric space representation by providing visual directional input thereby influencing spatial perception and attention
OPTOKINETIC STIMULATION

Additional studies on OKN and Neglect

- Vallar, et., al 1997 found positive effects from OKN visual displays on arm position and other arm and hand functions

- Sturm et., al. 2006, using the EYEMOVE program found reactivation of cortical regions including angular gyrus, temporal-occipital areas, pre-cuneus and the posterior cingulate gyrus
UNILATERAL SPATIAL INATTENTION (NEGLECT)

CONCLUSION
VISUAL-SPATIAL INATTENTION

Conclusion:

- Visual Spatial Inattention (Neglect) is a major source of stroke-related long-term disability
- Yoked prisms (prism adaptation), optokineti c stimulation and hemispatial sun Rx’s, appear to be useful tools to remediate unilateral spatial inattention
- The profession of Optometry has the potential to play an important role in applying these therapeutic modalities to remediate unilateral spatial inattention
THANK YOU
UNILATERAL SPATIAL INATTENTION

References
UNILATERAL SPATIAL INATTENTION

REFERENCES:


• Rizzolatti and Berti, Neglect as a neural representational deficit. Rev. Neurol. 146, 626-634, 1990


• Massucci, ME. Prism adaptation in the rehabilitation of patients with unilateral spatial inattention. J Behav Optom 2009; 20:101-105
UNILATERAL SPATIAL INATTENTION

REFERENCES:


• Milner , AD. and Goodale MA. The visual brain in action. Oxford University Press,1995
UNILATERAL SPATIAL INATTENTION

REFERENCES:


UNILATERAL SPATIAL INATTENTION

REFERENCES:


• Frassinetti F., Angeli V., Menegrello F., Avanzi S., Long-lasting amelioration of visuospatial neglect by prism adaptation. Brain 2002, 125:608-623


UNILATERAL SPATIAL INATTENTION

REFERENCES:


UNILATERAL SPATIAL INATTENTION

REFERENCES:

• Strum W., Thimm M., Fink, GR. Alertness training in neglect-Behavioural and imagining results. Restor Neurol and Neurosci, 2006;24(4-6):371-84