Brain-based methods of right stroke rehabilitation.

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“Not to be reproduced”
Renee Magritte, 1937

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• Disclosures: Have received honoraria from emedicine.com/WebMD
  – May mention off-label pharmacologic strategies for treating right brain disorders.

Outline

• Three clinical questions
• The right brain’s function
• Spatial neglect and its treatment
• Future directions
Why do hidden disabilities of right brain stroke result in so much social cost?

William O. Douglas
Woodrow Wilson
Roy Horn
Elisabeth Kubler-Ross

Has cognitive research on the right brain guided patient care?
"The great pleasure and feeling in my right brain is more than my left brain can find the words to tell you."
Sperry

The right brain and education.
Spatial neglect

Right brain disorders in the clinical setting

- Under-investigated
  - PubMed shows 12,088 records on aphasia but 1,344 on neglect.
- Under-treated
  - Defined clinical practice guidelines not yet available
- Under-recognized
  - Myth that cognitive disorders such as spatial problems are uncommon, especially chronically. (Likely over 300,000 acute US cases annually and over 200,000 chronic)

Right brain disorders in the clinical setting

- Under-detected
  - Right brain stroke under-represented at every stage of stroke care, from the ER to outpatient rehabilitation. (Foerch et al., 2003; Foro, 2005; Edwards et al., 2006)
  - Perhaps 1/3 of neglect patients in care facilities not detected by physicians or OTs.
Are we **translating** cognitive science in stroke neurology?

*for example:* right brain stroke

<table>
<thead>
<tr>
<th>BASIC SCIENCE phenomena</th>
<th>CLINICAL NEUROLOGY impairment</th>
<th>HEALTH OUTCOMES function and disability</th>
</tr>
</thead>
<tbody>
<tr>
<td>left-sided “where” unawareness of visual stimuli</td>
<td>left visual, tactile and auditory extinction</td>
<td>increased incidence of delirium</td>
</tr>
</tbody>
</table>

- Heilman, Watson & Valenstein, 2011; Mesulam et al., 1999
- Mesulam 1999
- Caeiro, Ferro, Albuquerque, Figueira, 2004

**The right brain’s functions:**

The right brain is critical for functions that are:

- Social
- Emotional
- Spatial

*An easy way to remember is the right brain helps maintain our “SES.”*

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**The right brain’s functions:**

- Most people are familiar with the left brain:
  - Speech and language
  - Numbers
  - Skilled learned movements (tool use)—both hands
  - Time perception
Body-spatial awareness and public health

- Increased morbidity (falls and accidents, medication compliance)
- Higher acute and post-acute care expense (can double length of stay)
  Gillen et al., 2005; Jehkonen et al., 2006
- “Hidden disability” leads to social isolation, shame, for caregivers and families

Nicholls et al., 2006
National Student Satisfaction Scale

"Definitely satisfied" responses increased (inflated) by 27% with left placement of positive end of scale

Barrett and Craver-Lemley, 2008
Body-based motor and somesthetic deficits

video

Three clinical questions

• Why do hidden disabilities after right brain stroke result in so much social cost?
  – 3D space is the fabric of reality
  – Spatial cognition and function are ignored
• Has cognitive research on the right brain guided patient care?
  – Not yet.
• Are we translating cognitive science in stroke neurology?
  – No... but we can.

“Classic comics” of neurology:

Cognition = cortical domain-specific modular information processing

Based on the work of Fodor, Marr, Nieser, others
Cognition

- Perceptual or input processes

- Multimodal representations

- Motor or output processes

- Semantics (meaning or concepts)

Spatial Cognition

- Sensation
  - WHERE spatial processing: attention, perception, awareness

- Perception
  - WHERE spatial processing: representations, imagery or mental maps

- Movement
  - WHERE spatial processing: intention, response planning, motor control

Perceptual-attentional “where” neglect.

Grooming video

From Baily Munson's blog on Wordpress
Neglect also affects internal representations

Boston Naming Test
Reading video

Aiming spatial neglect

Motor-intentional deficit
• Hypokinesia: limb, directional, hemispatial
• Asymmetric perseveration
• Asymmetric motor impersistence
• Asymmetric motor response inhibition

Heilman, Front Biosci, 2004

Barrett et al., 1999; Barrett & Burkholder, 2006; Khurshid et al., 2009; Fortis et al., 2011

Outline

• Three clinical questions
• Spatial function
• Spatial neglect and its treatment
• Conclusions
Aiming spatial neglect

left

right

Targeting stroke treatments

Comments, Opinions, and Reviews

The Case for Modality-Specific Outcome Measures in Clinical Trials of Stroke Recovery-Promoting Agents

Steven C. Cramer, MD; Walter J. Koroshetz, MD; Seth P. Finkbeiner, MD

Abstract: Clinical trials of acute stroke treatments have often used simple clinical rating scales as primary outcome measures of treatment efficacy. Recent pharmacological and clinical studies highlight the opportunity to utilize treatments in the subacute and chronic phase of stroke to promote neurological recovery. Because different neurological deficits recur in different ways, different interventions may exert differential effects on various functional aspects of stroke recovery. For this reason, we propose that the use of modality-specific outcome measures in clinical trials of stroke recovery-promoting agents. The use of such end points may result in a more objective testing of stroke recovery-promoting agents.

Key Words: clinical trials • outcome measures • stroke recovery

Separating Where versus Aiming function
Separating Where and Aiming spatial bias
construct validity in controls
Where/Aiming changes specifically altered by interventions
as predicted by hypotheses (patching, bromocriptine, prism adaptation)

Na et al., 1998
Garza et al., 2008; Barrett & Burkholder, 2006

John Garza
KF-NAP
Kessler Foundation Neglect Assessment Process

Kessler Foundation Neglect Assessment Process (Form A)
How to use the Catherine Bergego Scale to assess impaired spatial neglect

<table>
<thead>
<tr>
<th>Item #</th>
<th>Item description</th>
<th>0: no left neglect</th>
<th>1: mild neglect</th>
<th>2: moderate neglect</th>
<th>3: severe neglect</th>
<th>NA: (provide reasons)</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Limb awareness</td>
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<td></td>
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<td>2</td>
<td>Personal belongings</td>
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<tr>
<td>3</td>
<td>Dressing</td>
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<td>4</td>
<td>Grooming</td>
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<tr>
<td>5</td>
<td>Gaze orientation</td>
<td></td>
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<tr>
<td>6</td>
<td>Auditory attention</td>
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<td>7</td>
<td>Navigation</td>
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<td>8</td>
<td>Collisions</td>
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<td>9</td>
<td>Eating</td>
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<td>10</td>
<td>Cleaning after meal</td>
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</table>

Number of tested items = \( n \)
Sum of the score = \( S \)
Final Score = \( F \)

Neglect classification (score one): Absent (0), Mild (1-15), Moderate (16-20), Severe (21-30)

From impairment to disability
(Goedert, Chen, Botticello, Masmela, Adler, Barrett, APMR, 2012
A principal components analysis revealed two factors may underlie CBS performance in acute spatial neglect.
Prism adaptation and spatial neglect

Laterally displace viewed objects leftward 10-15º \textsuperscript{Rossi et al., 1990} plus motor practice with first part of arm movement obscured \textsuperscript{Rossetti et al., 1998}

Prisms and spatial neglect

May be the most promising treatment—case studies/series report observable improvement in functional performance, in 1 case long-lasting \textsuperscript{Humphreys et al., 2006; Keane et al., 2006} Our lab demonstrated (healthy controls, stroke with neglect) specific effects on spatial Aiming \textsuperscript{(Fortis et al., Neuropsychologia, 2011; Fortis et al., Neuroreport, 2011)}

AIMING BIAS predicted prism adaptation recovery.

CBS – Functional Scale
- As predicted, subjects with "Where" bias did not improve, but subjects with Aiming bias did improve.
  - Aiming or Aiming+Where bias (b=−0.37 and b=−0.24, ps<.001) improved.
  - Patients with isolated Where bias did not improve (b=0.00, p =.980).

Goedert et al., NNR, 2013
KF-PAT
Kessler Foundation Prism Adaptation Treatment

- Videos

Chen et al., 2012
*Brain Imaging and Behavior*
Frontal lesion patients had larger strokes.

Future Directions....
Conclusions

• Right brain treatment may need to target the special problems of these stroke survivors: social, emotional and spatial.
• Body-spatial awareness and Aiming spatial neglect may be tremendously disabling in activities of daily living.
• Identifying Aiming spatial neglect may be more difficult, but it probably responds to Prism Adaptation therapy.

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