The application of cognitive neuroscience knowledge for unilateral neglect patients in occupational therapy – spatiomotor cueing

Ru-Jun, Huang (黃如君)
Buddhist Tzu Chi General hospital, Taichung Branch, Taiwan.

(outline)

Introduction about unilateral neglect
1. Representation model
2. Attentional bias model
3-part semi-independent spatial system
Spatio-motor cueing
1. Neural plasticity
2. Hebbian rule
3. Parallel distributed precessing
4. Oriented theory of neglect
Application
What is unilateral neglect?

- a failure to report, respond or orient to stimulation presented on the side opposite to a brain lesion (Heilman et al., 1985)

- attentional problem
- inferior parietal cortex (Georg Kerkho, 2001)
- right hemisphere (Robertson, I.H. and Marshall, J.C., eds, 1993)

Representational model

Left hemisphere
have attentional representation of right hemispace

Right hemisphere
have attentional representation of right & left hemispace

does not lead to significant contralesional neglect
is capable of allocating spatial attention toward left and right
Attentional bias model

Leftward attention

Inhibitory circuitry

Rightward attention

Right-hemisphere lesion...

Rightward attention
Spatial representation theory

(Rizzolatti, G. and Camarda, R., 1987)

the space of the body surface

processing of the space within arm’s reach

Sensory events coming from spaces

(Robertson, I.H. and North, N., 1992)

Space maps dynamically calibrated

independent and inter-dependent

controlled by independent but coordinated neuronal circuits

personal and reaching space

(Robertson, I.H. and North, N., 1992)
Spatio-motor cueing

- biasing of attention towards one side by virtue of making a response with that side of the body (Halligan, P. W., Manning, L. Marshall, J. C., 1991)

Recruitment hypothesis: (Rizzolatti, G. and Camarda, R., 1987)
- left hand activation in either hemispace?

Cueing hypothesis: (Halligan, P. W., Manning, L. Marshall, J. C., 1991)
- movements by either hand on the left side?

Spatio-motor cueing

- Left hand movement in either hemispace
- Either hand on left side

the left hand act on the left side
Why can decrease??

- **Neural plasticity**
  - the capacity of the central nervous system to adapt to functional demand and therefore to the system’s capacity to reorganize

- **Hebbian rule** (1949)
  - synaptic plasticity
  - changes in synaptic efficacy would take place when a pre-synaptic cell participated in firing a post-synaptic cell (fired together, wired together)

Why can decrease??

- **Parallel distributed processing approach**
  - cognitive activities emerge from the interaction of large number of simple processing unit
  - units distribute both within and cross brain

  - example
Why can decrease??

- **Oriented theory of neglect** (Rezzolatti et al., 1997)
  - space representation is enabled by the activity of premotor cortical structures
  - the structures are linked closely to attention
  - encompass **attentional and motor** neglect phenomena

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**Why can decrease??**

- voluntary movements with his left hand in left hemispace
- personal spatial sector active
- Integration
- enhancing reaching spatial sector

![Diagram](image)
Application

we know why neglect is a common result of right hemisphere damage

allows us understand what happens after right brain damage occurs

Application

1. divides space into three independent and inter-dependent spatial systems
2. proposes that patients with neglect usually have impairment in personal and reaching space

the biasing of attention towards one side by virtue of making a response with that side of the body
left hand in the left hemispace was the most effective

1. Hebbian rule: emphasizes the synaptic plasticity
2. Parallel distributed processing approach: cognitive activity requires integration among many processing units
3. Through integration, intact neural circuitry can enhance the function of impaired neural circuitry

 OT usually use goal-directed tasks to improve patients’ impairment
 these tasks are commonly designed with a canonical set of components in mind
 However, in my work, I hope to introduce the rich and untapped field of cognitive neuroscience into the process of task design
 for the kind of neglect described above, I propose that we design tasks involving the idea of "the left hand act on the left side" / "affected side explores affected side"
Personal space

Reaching space

Thanks for your attention
non-specific stimulation can inadvertently strengthen nondamaged competitor circuits or it might simply fail to provide the type of precisely shaped and timed input that is needed to foster changes in a particular lesioned network

Cognitive neuroscience can make a significant contribution towards the development of a scientific basis for the practice of brain rehabilitation through elucidating the brain’s functional architecture.

reference

reference


Type of unilateral neglect

- **Object-based neglect**
  - ![Patient copy](image1)
  - ![STG](image2)
- **Non-object-based neglect**
  - ![Patient copy](image3)
  - ![IPL/TPJ](image4)
What is unilateral neglect?

- extinction (prominent feature of neglect)