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Brain stimulation and visuo-spatial improvement for neglect patients: Description of two cases

Institut régional de médecine physique et de réadaptation, rue du Pr-Montaut,
54690 Lay Saint Christophe, France
⁎Corresponding author.
E-mail address: matthieu.kandel@sante-lorraine.fr.

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Neglect syndrome is frequently associated with right hemisphere stroke. The concept of interhemispheric competition is being put forward increasingly to explain this syndrome [1]. Therefore, any intervention aiming at restoring balance between the two hemispheres could be useful. Non-invasive brain stimulations (transcranial Direct Current Stimulation [tDCS] and repetitive Transcranial Magnetic Stimulation [rTMS]) have already shown their ability to modify cortical excitability [2]. Their use to restore interhemispheric balance after a stroke would therefore appear interesting. Few studies have evaluated these techniques as a potential treatment for neglect patients: most of them have used rTMS [3,4].

In a pilot study, we aimed at replicating with tDCS the results that were obtained with rTMS. Two patients had two stimulation sessions of the left parietal lobe (inhibition with cathodic stimulation, or sham stimulation). Evaluation of visuo-spatial performances (line bisection and the bell test) was performed before, during and immediately after the stimulation.

For one patient, rightward bisection bias was significantly reduced during real stimulation (0.8% bias versus 18.5% pre-test) but not sham stimulation (22.4% versus 17.3%). Visual exploration improved (+30% target found, 4.1% during sham stimulation). For the second patient, bisection bias was stable in both conditions. Visual exploration was better after real stimulation (+26% targets versus –3.2% during sham stimulation).

Those first results confirm that inhibitory stimulation of the left hemisphere parietal lobe can improve visuo-spatial performances for left neglect patients. More results are necessary to statistically confirm these findings.

References

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Spatial cognition and virtual reality: Review and interest for rehabilitation

B. Glize a,⁎, G. Rode b,⁎, E. Klinger c, P.A. Joseph d
a EA 4136, service de MPR, pôle de neurosciences clinique, université Bordeaux-Segalen, CHU de Bordeaux, CHU Pellegrin, place Amélie-Raba-Léon, 33076 Bordeaux, France
b Service de médecine physique et réadaptation, hôpital Henri-Gabrielle, hospices civils de Lyon, 69230 Saint-Génis-Laval, France
c Équipe Impact, 6, Inserm U1028, CNRS UMR 5292, centre de recherche en neurosciences de Lyon, université Claude-Bernard Lyon I, Lyon, France
d Arts et métiers ParisTech LAMPA–EA 1427, Angers-Laval, France
⁎Corresponding author.
E-mail address: bertrand.glize@chu-bordeaux.fr.

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Disorders of spatial cognition are often associated with neglect syndrome and most often are induced by right hemisphere injury. Unilateral neglect is a neurological deficit of perception, attention, representation, performing actions within their left-sided space, inducing many functional debilitating effects altering everyday life, and responsible for poor functional recovery and ability to benefit from treatment. Several techniques have been proposed in the last decades, but only a few have shown long-lasting effects and none have provided complete rehabilitation. Virtual reality (VR) is a possible way to overcome time, economic and physical constraints limiting clinicians’ opportunities to observe patients’ performance at complex daily tasks.

Moreover, VR technology offers the potential to assist current rehabilitation techniques in addressing the impairments, disabilities, and handicaps associated with brain damage.

In the domain of spatial cognition, VR is a relatively new tool that has just begun to be adopted to assess and rehabilitate spatial cognition disorders, especially unilateral neglect. This technology enables not only to study but also affect perception, attention, and moving in an explored space as well as learning and mental representation of the learnt environment. This emerging treatment appears to be promising for rehabilitation medicine.

Here, we review the main studies using VR to explore the mechanisms of spatial cognition and mental imagery. This review also describes studies that have used VR in the assessment and rehabilitation of spatial ability impairments, especially unilateral neglect. Finally, we will try to purpose the main issues of VR and spatial cognition in clinical practice and research in physical and rehabilitation medicine.

Further reading

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Bottom-up effect of prism adaptation on hemineglect in virtual spatial domain

B. Glize a,⁎, S. Jacquin-Courtois a,⁎, M. Lunven b,⁎, F. Cotton b,⁎, S. Chapeau a,⁎, E. Klinger c, P.A. Joseph d, G. Rode b,⁎
a EA 4136, service de MPR, pôle de neurosciences clinique, université Bordeaux-Segalen, CHU de Bordeaux, CHU Pellegrin, place Amélie-Raba-Léon, 33076 Bordeaux, France
b Service de médecine physique et réadaptation, hôpital Henri-Gabrielle, hospices civils de Lyon, 69230 Saint-Génis-Laval, France
c Équipe Impact, 6, Inserm U1028, CNRS UMR 5292, centre de recherche en neurosciences de Lyon, université Claude-Bernard Lyon I, Lyon, France
d Arts et métiers ParisTech LAMPA–EA 1427, Angers-Laval, France
⁎Corresponding author.
E-mail address: bertrand.glize@chu-bordeaux.fr.

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Unilateral neglect is a disabling syndrome due to right hemisphere brain damage. Prism adaptation (PA) has been used to improve several aspects of unilateral neglect. Parameters ranging from the classical neuropsychological tests to mental imagery or to others sensory modalities have been successfully ameliorated following a brief period of adaptation to wedge prisms shifting the visual field to the right. The aim of the study was to assess whether the beneficial ‘bottom-up’ effects of PA may generalize to a virtual spatial domain. Seven right brain-damaged patients with a left chronic neglect were included. After-effect of PA was assessed by measure of straight-ahead pointing movements in darkness. Cognitive effects were assessed by neuropsychological tests and by a virtual reality task: the patient had to explore a virtual supermarket.