

بِسْمِ اللَّهِ الرَّحْمَنِ الرَّحِيمِ





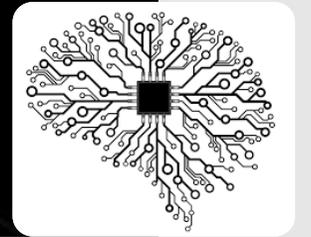
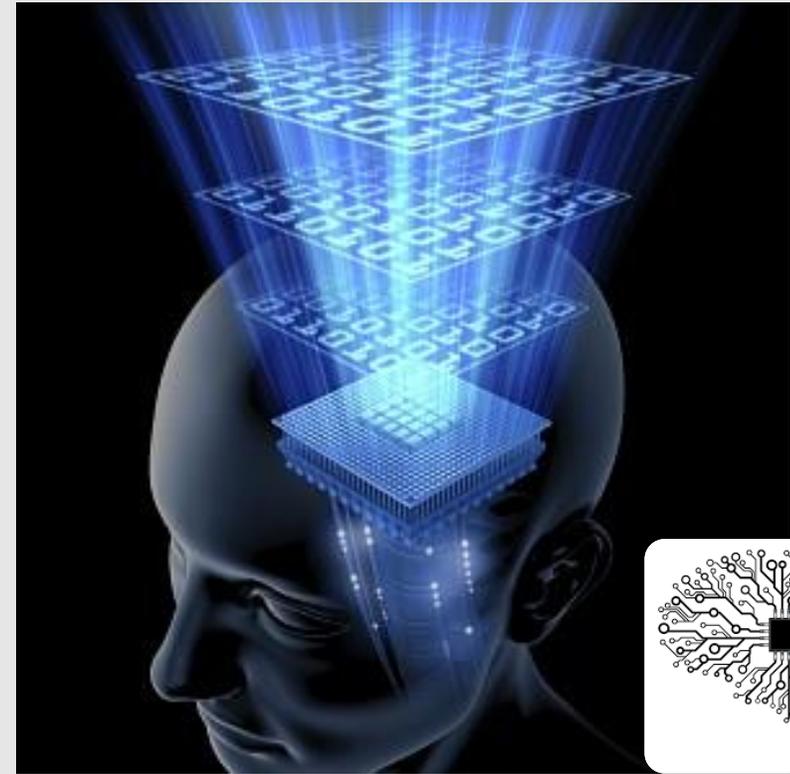
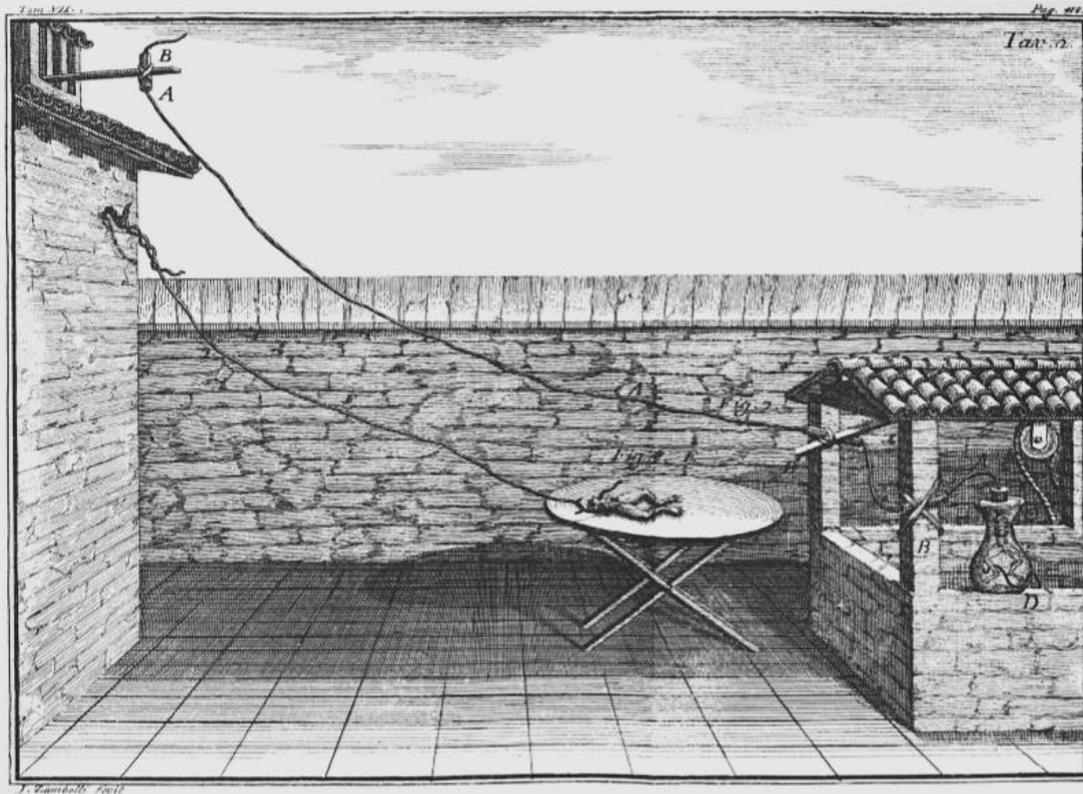
Applications of **GVS**

By:

Dr. Moslem Shaabani

Assistant Professor (USWR)

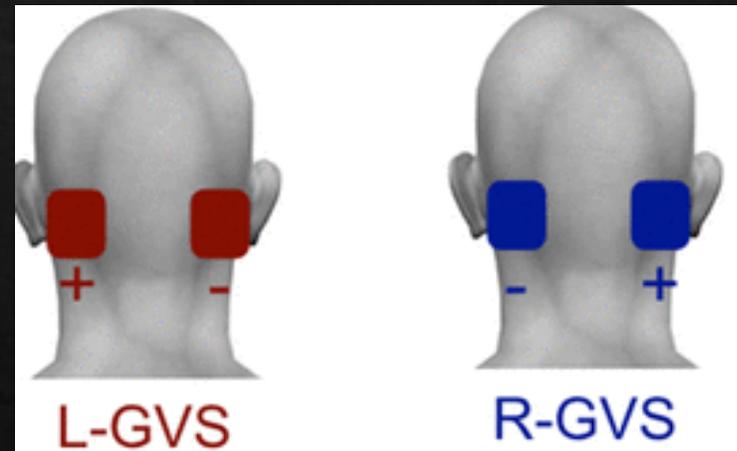
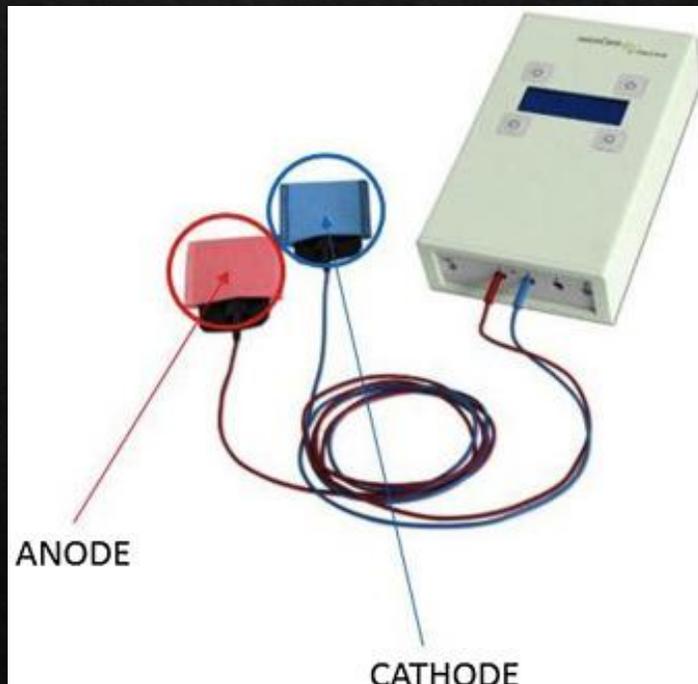
From Galvani to Neuromorphic engineering



Galvanic Vestibular Stimulation (GVS)

Device and Electrode montage

Stimulation Types and Levels

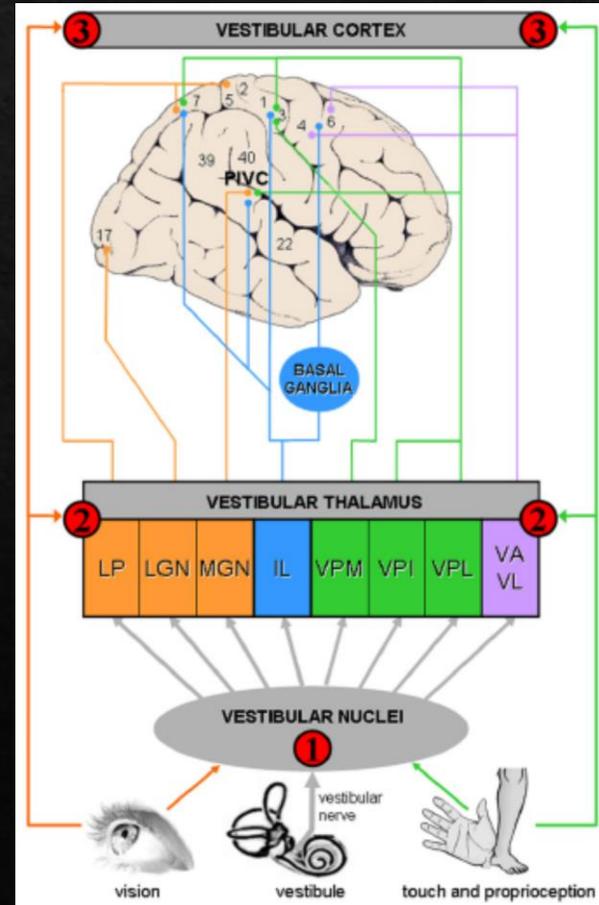
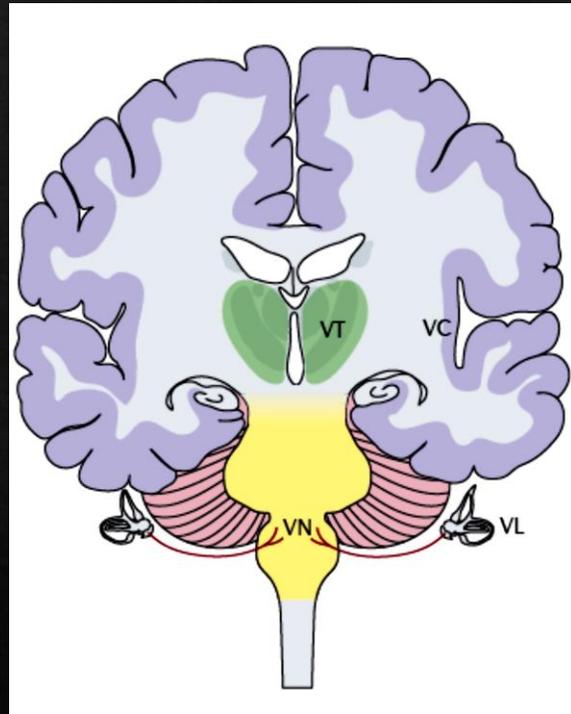
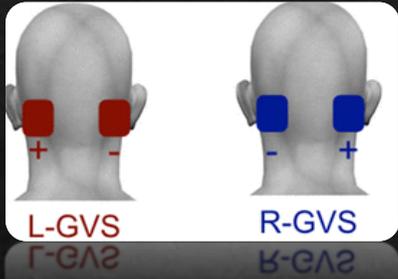


Pulsatile
Sinusoidal
Stochastic or noisy GVS (nGVS)

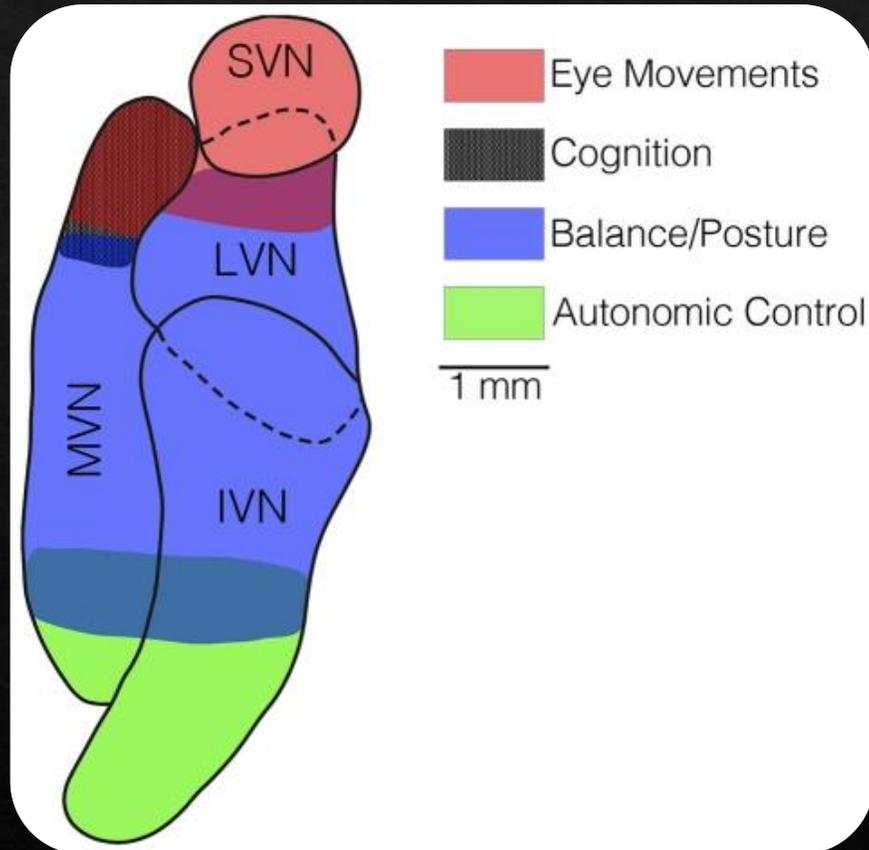
Threshold Level
Sub-threshold level
Supra-threshold level

Galvanic Vestibular Stimulation (GVS)

Potential neural pathway



Galvanic Vestibular Stimulation (GVS) Potential applications



frontiers in
NEUROLOGY

REVIEW ARTICLE
published: 27 December 2011
doi: 10.3389/fneur.2011.00088



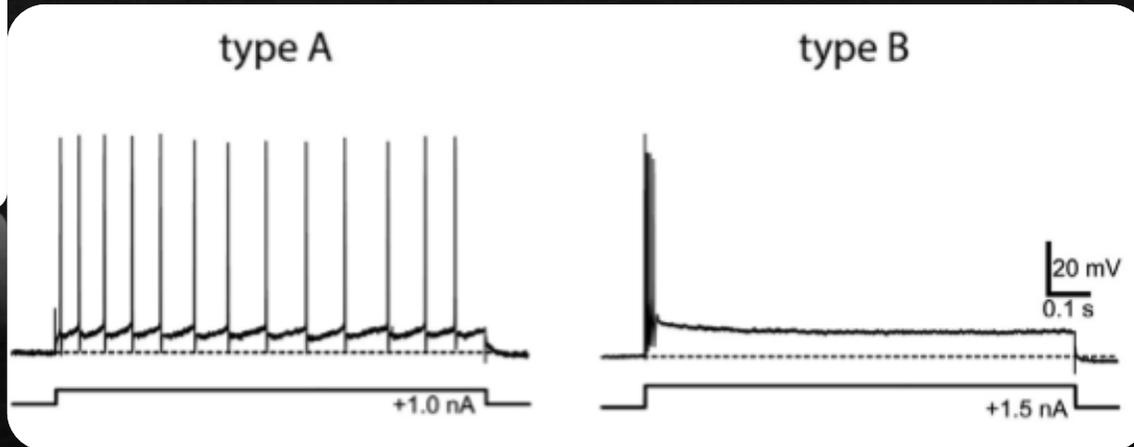
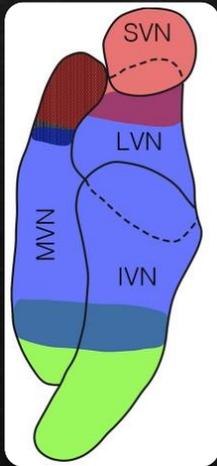
Compensation following bilateral vestibular damage

Andrew A. McCall and Bill J. Yates*

Department of Otolaryngology, University of Pittsburgh, Pittsburgh, PA, USA

Galvanic Vestibular Stimulation (GVS)

Potential applications (based on two vestibular systems)



frontiers
in Neurology

REVIEW
published: 30 March 2017
doi: 10.3389/fneur.2017.00117

Check for updates

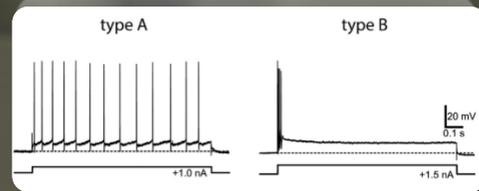
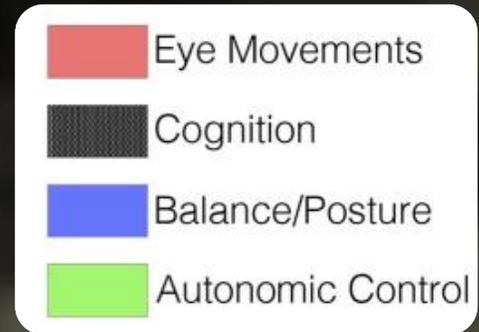
Sustained and Transient Vestibular Systems: A Physiological Basis for Interpreting Vestibular Function

Ian S. Curthoys^{1*}, Hamish G. MacDougall¹, Pierre-Paul Vidal² and Catherine de Waele²

1 Department of Neurology, University of Toronto, Toronto, ON, Canada; 2 Department of Neurology, University of Liège, Liège, Belgium

Interpreting Vestibular Function

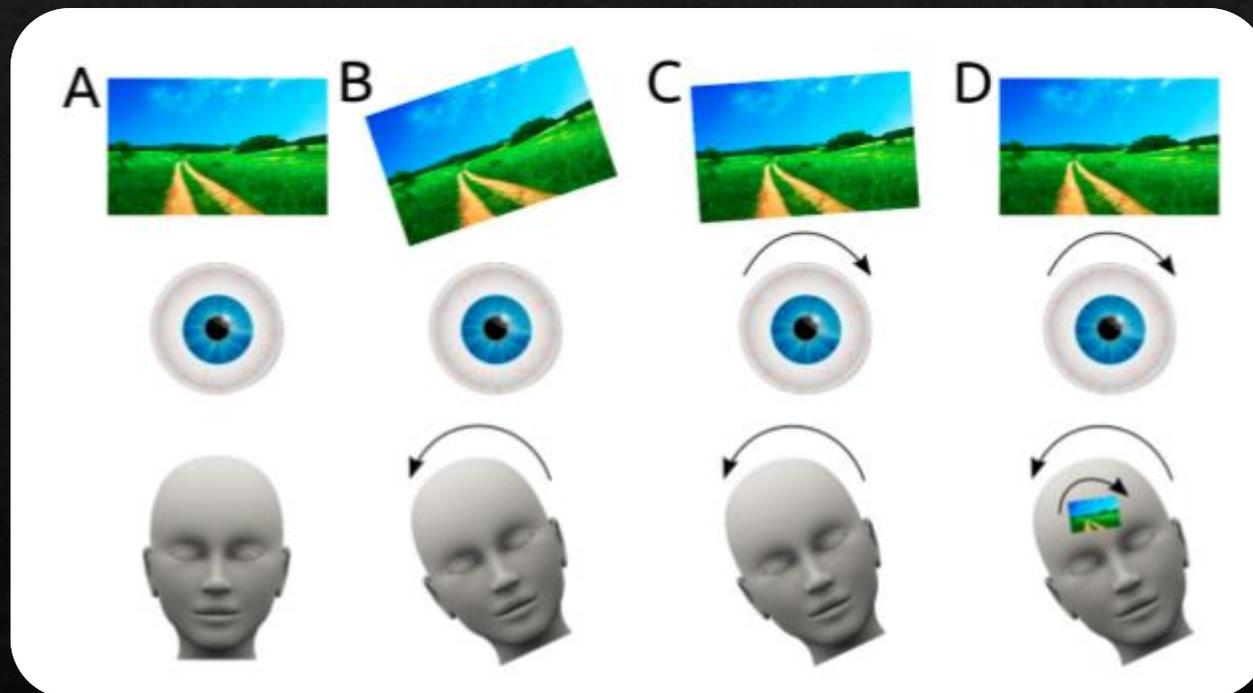
- ◇ Basic Science applications
- ◇ Evaluation applications
- ◇ Interventional and Clinical applications



GALVANIC VESTIBULAR STIMULATION (GVS) POTENTIAL APPLICATIONS

Galvanic Vestibular Stimulation (GVS)

Basic science: Ocular torsion and Ocular tilt



Article

Beyond the Vestibulo-Ocular Reflex: Vestibular Input is Processed Centrally to Achieve Visual Stability

Edwin S. Dalmajjer

MRC Cognition and Brain Sciences Unit, University of Cambridge, Cambridge CB2 1TN, UK; edwin.dalmajjer@mrc-cbu.cam.ac.uk; Tel.: +44(0)-1223-355-294

αριθμός επικοινωνίας: +44(0)-1223-355 294
MRC, Σχολή Ανθρώπινης Γνώσης και Επιστήμης του Εγκεφάλου, Πανεπιστήμιο της Καμβρίας, Cambridge CB2 1TN, UK
E-mail: edwin.dalmajjer@mrc-cbu.cam.ac.uk

Galvanic Vestibular Stimulation (GVS)

Basic Science: Gain regulation mechanism

Visual-vestibular modulation; Somatosensory-vestibular modulation

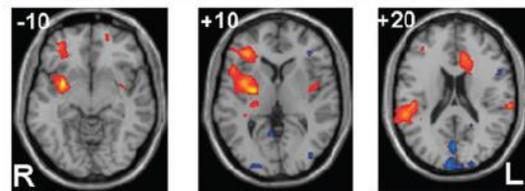
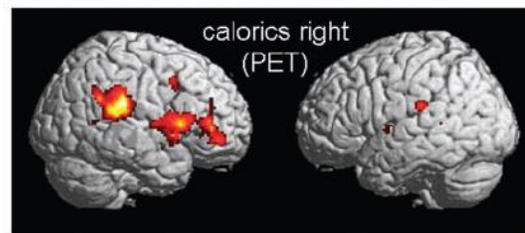
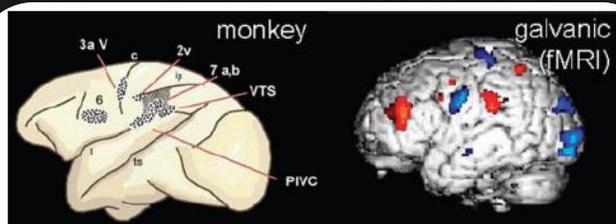
doi:10.1093/brain/awn042

Brain (2008), 131, 2538–2552

REVIEW ARTICLE

Functional brain imaging of peripheral and central vestibular disorders

Marianne Dieterich¹ and Thomas Brandt²

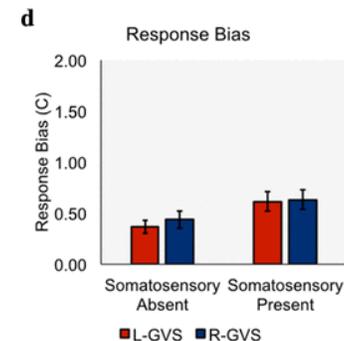
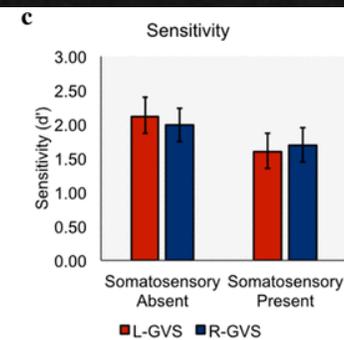
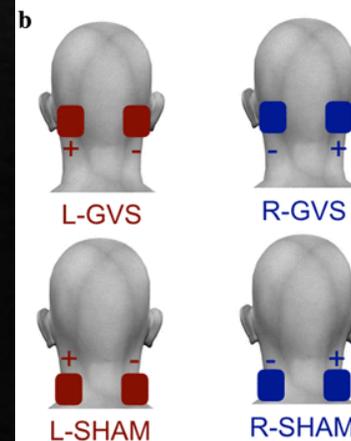
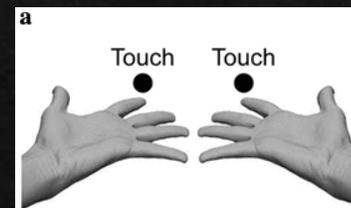


Experimental Brain Research (2018) 236:859–865
<https://doi.org/10.1007/s00221-018-5167-9>

RESEARCH ARTICLE

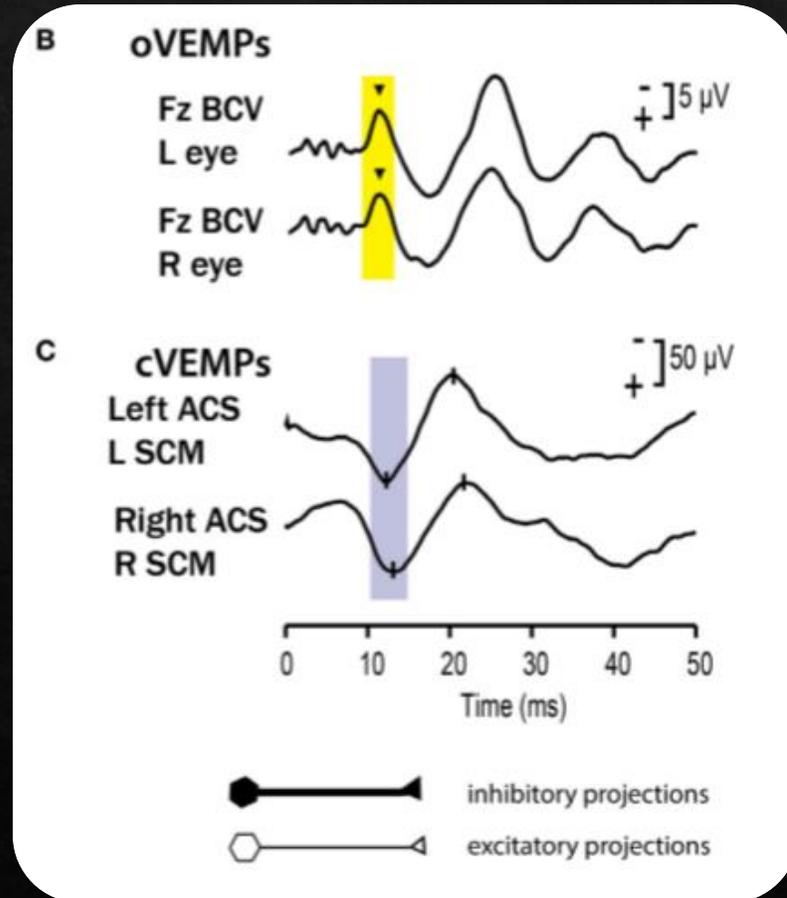
Somatosensory modulation of perceptual vestibular detection

Katerina Cabolis¹ · Anne Steinberg¹ · Elisa Raffaella Ferrè¹



Galvanic Vestibular Stimulation (GVS)

Evaluation: **VEMPs**



Sustained and Transient Vestibular Systems: A Physiological Basis for Interpreting Vestibular Function

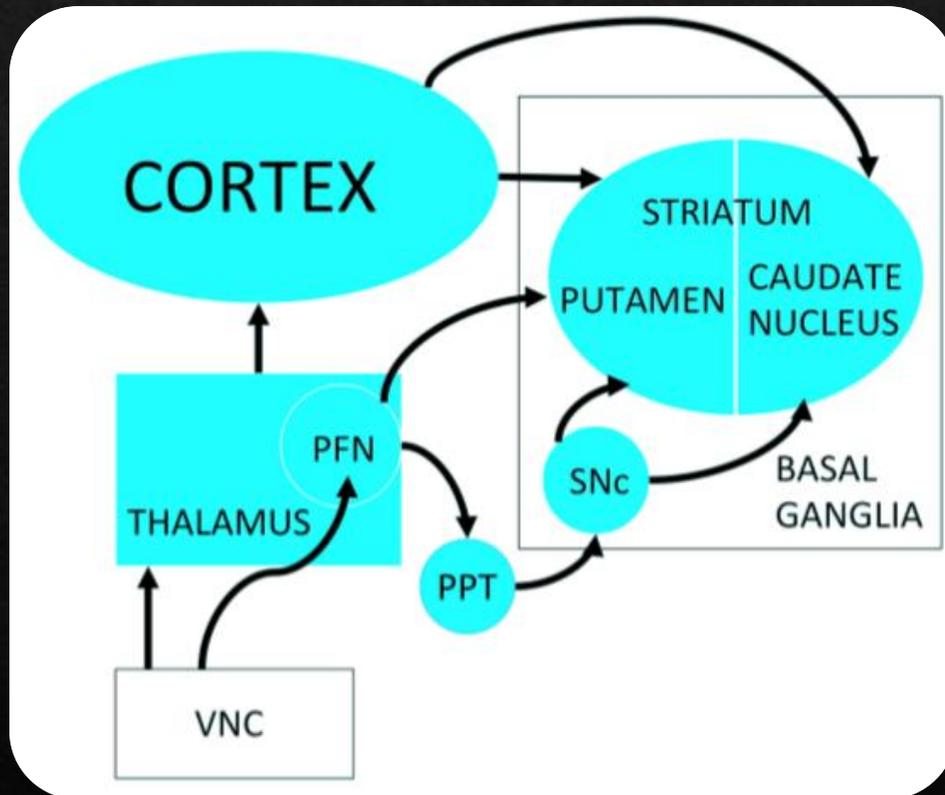
Ian S. Curthoys^{1*}, Hamish G. MacDougall¹, Pierre-Paul Vidal² and Catherine de Waele³

¹Department of Neurology, University of Toronto, Toronto, ON, Canada; ²INSERM U1128, Centre de Neurosciences Cognitives, Université de Bordeaux, Bordeaux, France; ³Department of Neurology, University of Toronto, Toronto, ON, Canada

Interpreting Vestibular Function

Galvanic Vestibular Stimulation (GVS)

Intervention: **Parkinson's Disease**



Vestibular Functions and Parkinson's Disease

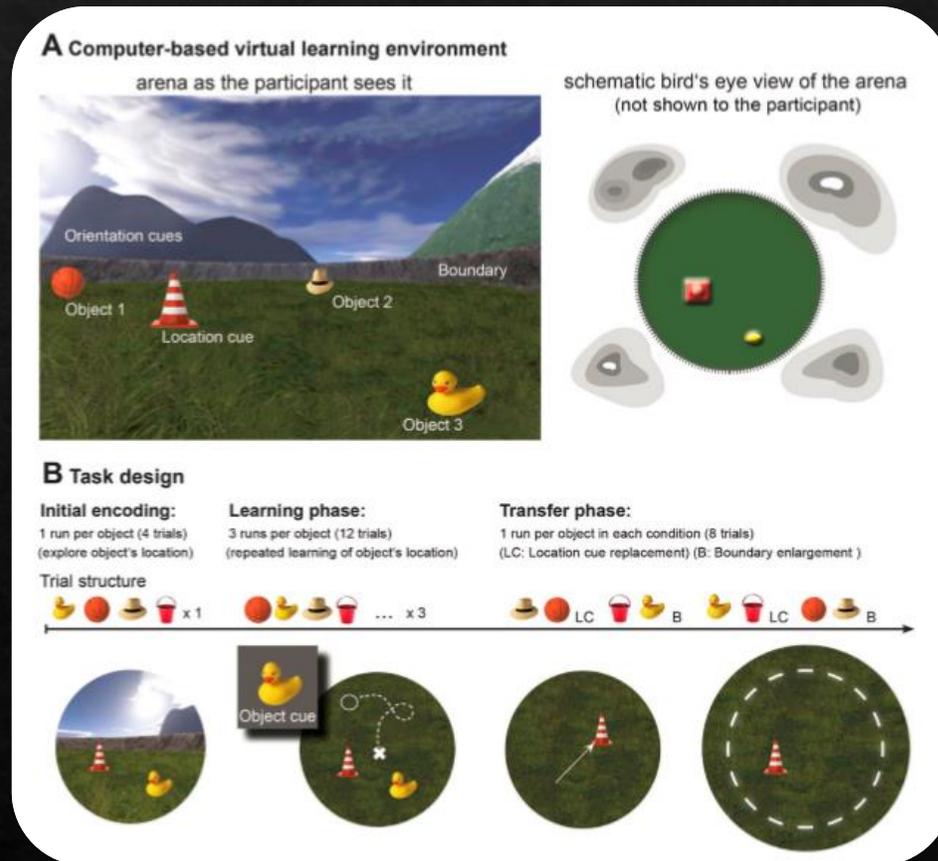
Paul F. Smith^{1,2*}

Paul F. Smith^{1,2*}

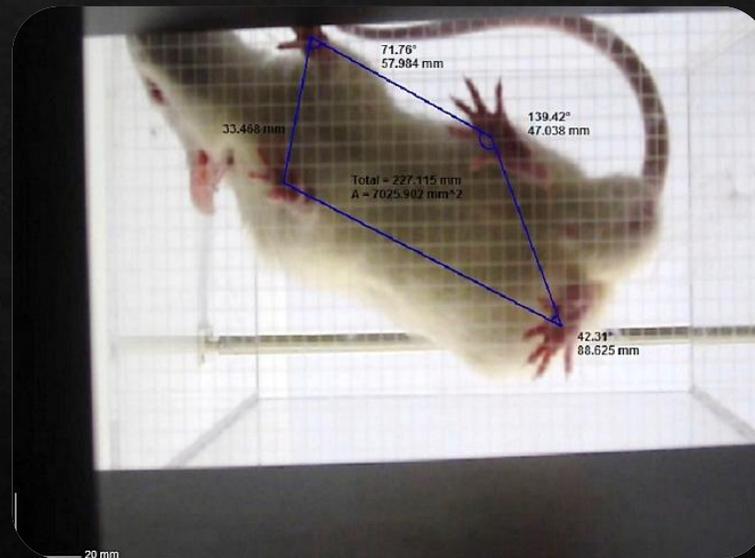
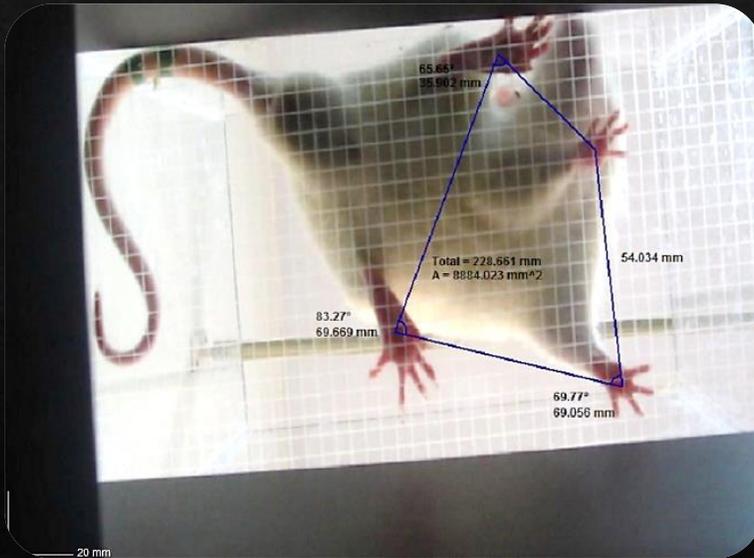
0126926

Galvanic Vestibular Stimulation (GVS)

Intervention: Spatial memory (Hippocampal, Striatal)



Galvanic Vestibular Stimulation (GVS) Intervention: Vestibular rehabilitation in UW rats



Brain Research 1648 (2016) 152–162

Contents lists available at ScienceDirect

Brain Research

journal homepage: www.elsevier.com/locate/brainres

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Research report

Short-term galvanic vestibular stimulation promotes functional recovery and neurogenesis in unilaterally labyrinthectomized rats

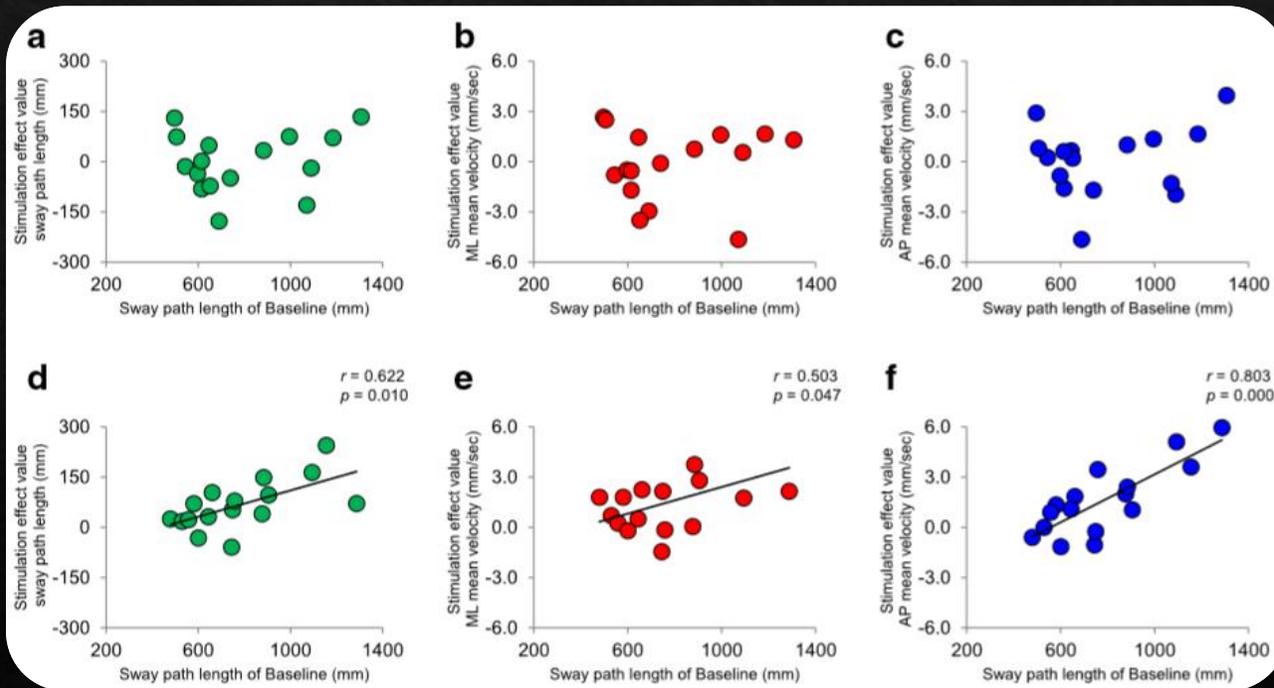
Moslem Shaabani^a, Yones Lotfi^{a,*}, Seyed Morteza Karimian^b, Mehdi Rahgozar^c, Mehdi Hooshmandi^d

^a Audiology Department, University of Social Welfare and Rehabilitation Sciences, Tehran, Iran
^b Department of Physiology, School of Medicine, Tehran University of Medical Sciences, Tehran, Iran
^c Biostatistics Department, University of Social Welfare and Rehabilitation Sciences, Tehran, Iran
^d Department of Physiology, Medical School, Shahid Beheshti University of Medical Sciences, Tehran, Iran

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Galvanic Vestibular Stimulation (GVS)

Intervention: COP sway and Falling
Sway path length; ML mean velocity; AP mean velocity



Inukai et al. *Journal of NeuroEngineering and Rehabilitation* (2018) 15:63
<https://doi.org/10.1186/s12984-018-0407-6>

Journal of NeuroEngineering
and Rehabilitation

RESEARCH

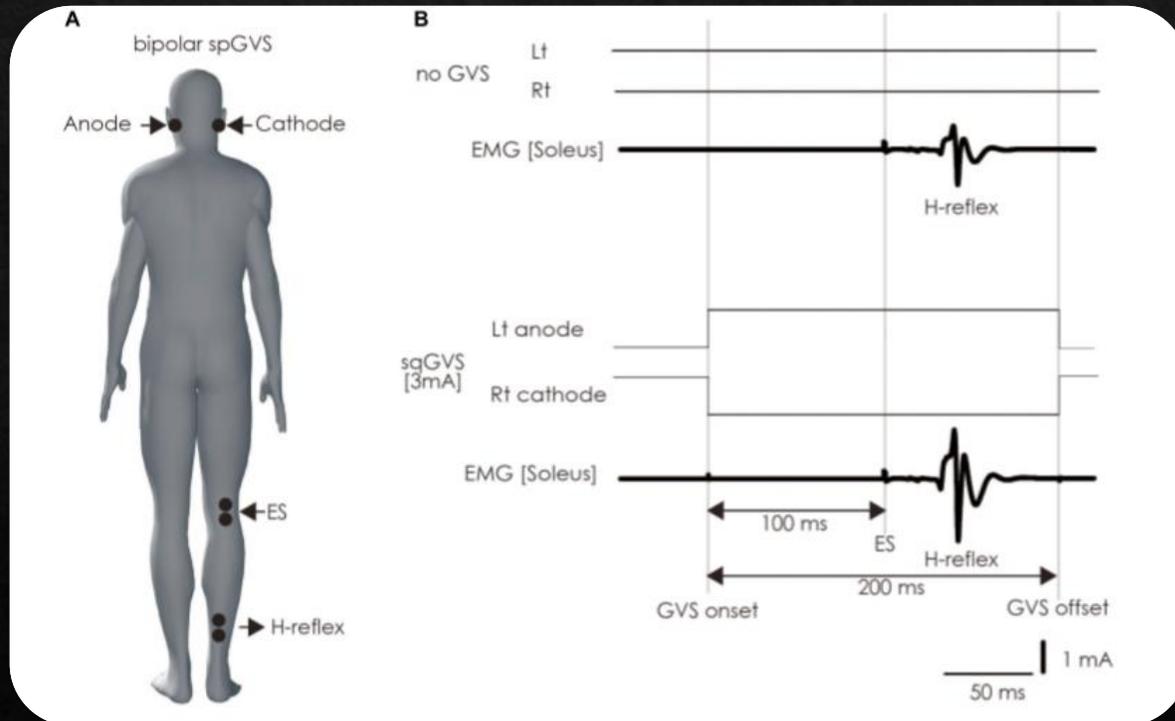
Open Access



Effect of noisy galvanic vestibular stimulation in community-dwelling elderly people: a randomised controlled trial

Yasuto Inukai^{1,2*}, Mitsuhiro Masaki^{1,2}, Naofumi Otsuru^{1,2}, Kei Saito^{1,2}, Shota Miyaguchi^{1,2}, Sho Kojima^{1,2} and Hideaki Onishi^{1,2}

Galvanic Vestibular Stimulation (GVS) Basic Science and Intervention: **VSR function**



Cerebellar Repetitive Transcranial Magnetic Stimulation and Noisy Galvanic Vestibular Stimulation Change Vestibulospinal Function

Akiyoshi Matsugi^{1*}, Shinya Douchi², Rikiya Hasada³, Nobuhiko Mori^{4,5}, Yohei Okada^{6,7}, Naoki Yoshida^{8,9}, Satoru Nishishita^{8,9}, Koichi Hosomi^{14,5} and Youichi Saitoh^{14,5}

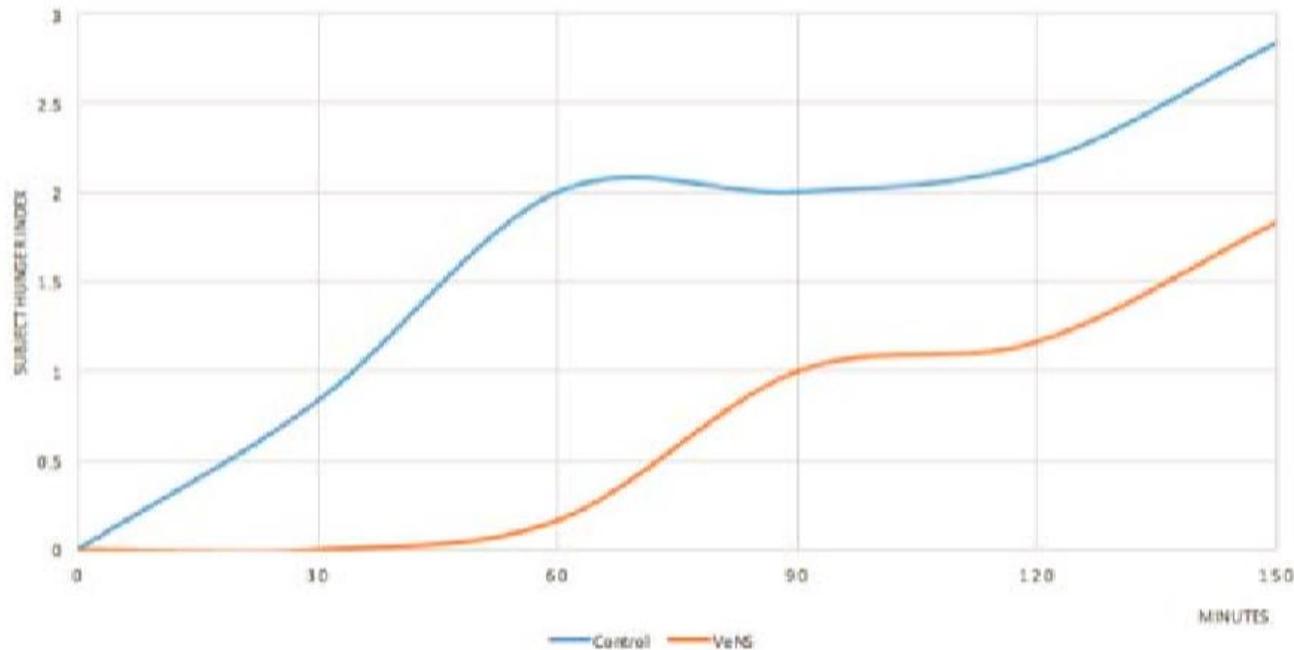
1Department of Neurophysiology, National Institute of Advanced Industrial Science and Technology, Tsukuba, Japan, 2Department of Neurophysiology, National Institute of Advanced Industrial Science and Technology, Tsukuba, Japan, 3Department of Neurophysiology, National Institute of Advanced Industrial Science and Technology, Tsukuba, Japan, 4Department of Neurophysiology, National Institute of Advanced Industrial Science and Technology, Tsukuba, Japan, 5Department of Neurophysiology, National Institute of Advanced Industrial Science and Technology, Tsukuba, Japan, 6Department of Neurophysiology, National Institute of Advanced Industrial Science and Technology, Tsukuba, Japan, 7Department of Neurophysiology, National Institute of Advanced Industrial Science and Technology, Tsukuba, Japan, 8Department of Neurophysiology, National Institute of Advanced Industrial Science and Technology, Tsukuba, Japan, 9Department of Neurophysiology, National Institute of Advanced Industrial Science and Technology, Tsukuba, Japan, 10Department of Neurophysiology, National Institute of Advanced Industrial Science and Technology, Tsukuba, Japan, 11Department of Neurophysiology, National Institute of Advanced Industrial Science and Technology, Tsukuba, Japan, 12Department of Neurophysiology, National Institute of Advanced Industrial Science and Technology, Tsukuba, Japan, 13Department of Neurophysiology, National Institute of Advanced Industrial Science and Technology, Tsukuba, Japan, 14Department of Neurophysiology, National Institute of Advanced Industrial Science and Technology, Tsukuba, Japan

Change Vestibulospinal Function

Galvanic Vestibular Stimulation (GVS)

A probable future application in weight loss diet!

INCREASE IN APPETITE FROM 8AM BASELINE



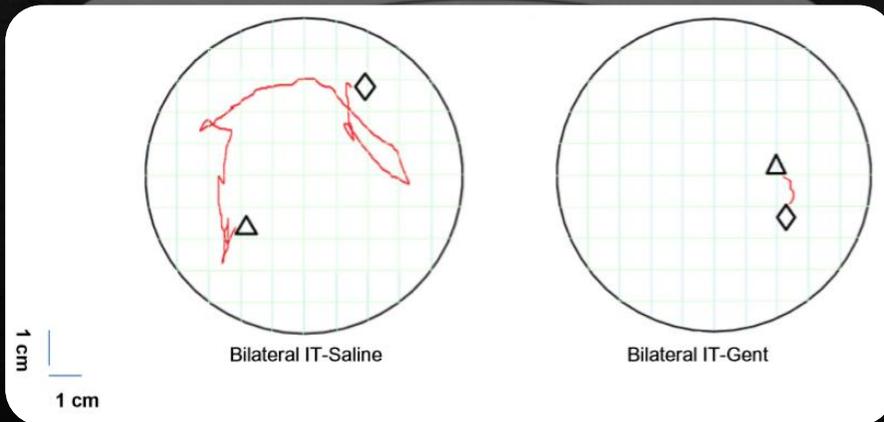
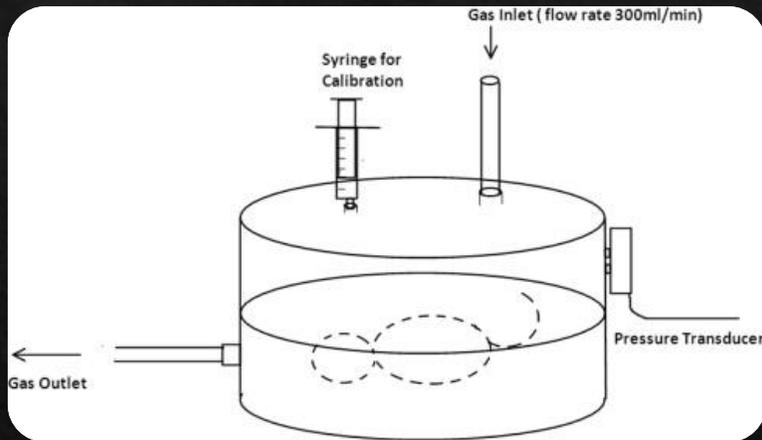
Modulation of Body Mass Composition using Vestibular Nerve Stimulation.

Paul D. McGeoch, Jason McKeown, Hans Peterson & V.S. Ramachandran

Center for Brain and Cognition,
University of California, San Diego,
Mandler Hall, 9500 Gilman Drive #0109,
La Jolla, CA 92093-0109

USA

Galvanic Vestibular Stimulation (GVS) A probable future application in SIDS!



Early Human Development (2008) 84, 225–229
available at www.sciencedirect.com
ScienceDirect
www.elsevier.com/locate/earhdev

**Newborn oto-acoustic emission hearing screening tests
Preliminary evidence for a marker of susceptibility
to SIDS**

Daniel D. Rubens^{a,*}, Betty R. Vohr^b, Richard Tucker^b,
Courtney A. O'Neil^c, Winnie Chung^c

Neuroscience 175 (2011) 262–272

INNER EAR INSULT SUPPRESSES THE RESPIRATORY RESPONSE TO CARBON DIOXIDE

T. ALLEN,^a G. JURIC-SEKHAR,^b S. CAMPBELL,^c
K. E. MUSSAR,^b K. SEIDEL,^d J. TAN,^a M. ZYPHUR,^a
L. VILLAGRACIA,^a D. STEPHANIAN,^a H. KOCH,^b
J. M. RAMIREZ^b AND D. D. RUBENS^{a*}

Vestibular organ stimulation increases respiration in human subjects (Miyamura et al., 2004; Monahan et al. 2002). Activation of the semicircular canals by dynamic yaw, lateral pitch, and roll movements mediates an

Neuroscience 253 (2013) 283–291

INNER EAR INSULT ABLATES THE AROUSAL RESPONSE TO HYPOXIA AND HYPERCARBIA

T. ALLEN,^{a†} A. J. GARCIA III,^{b†} J. TANG,^{b‡}
J. M. RAMIREZ^{b,c,d†} AND D. D. RUBENS^{a*}

was significantly decreased in the bilateral ear IT-Gent-treated mice (n = 19) compared to saline-treated mice (n = 19).

Neuroscience 337 (2016) 9–16

INNER EAR LESION AND THE DIFFERENTIAL ROLES OF HYPOXIA AND HYPERCARBIA IN TRIGGERING ACTIVE MOVEMENTS: POTENTIAL IMPLICATION FOR THE SUDDEN INFANT DEATH SYNDROME

SANJA RAMIREZ,^b TRAVIS ALLEN,^{a,b,c}
LINDSAY VILLAGRACIA,^b YOOREE CHAE,^b
JAN M. RAMIREZ^{b,d} AND DANIEL D. RUBENS^{a,b,c,*}

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Galvanic Vestibular Stimulation (GVS)

A probable future application in Psychology!

OUT-OF-BODY

Stimulation of the **right angular gyrus** resulted in an out-of-body experience, as if the patient were floating from the ceiling, looking down at herself.



Perceived location



Actual location

frontiers in
INTEGRATIVE NEUROSCIENCE

REVIEW ARTICLE
published: 17 April 2014
doi: 10.3389/fnint.2014.00031



The vestibular system: a spatial reference for bodily self-consciousness

Christian Pfeiffer^{1,2}, Andrea Serino^{1,2,3} and Olaf Blanke^{1,2,4*}

Christian Pfeiffer^{1,2}, Andrea Serino^{1,2,3} and Olaf Blanke^{1,2,4*}

Conclusion

Lesson 1.

**Specific stimulation but
widespread modulation**

Lesson 2.

**Visual-Vestibular
modulation**

Lesson 3.

**Somatosensory-Vestibular
modulation**

Lesson 4.

Vestibular rehabilitation

Lesson 5.

**Vestibulo-autonomic
modulation**

THANK YOU!



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