8:00  Breakfast and registration
8:30  Welcome speech: Pr G. Stoquart

First Session - Chairs: Kristine Oostra & Yves Vandermeeren
9:10  Dr D. Charles (University of Ulster, United Kingdom) “Games and virtual reality for stroke rehabilitation”
9:50  Pr M. Edwards (UCL) “The use of new technology for diagnosis and rehabilitation in perception and action”

10:30  Coffee break - posters and sponsors exhibition

Second Session - Chairs: Thierry Lejeune & Geert Verheyden
11:00  Pr A. Meyer-Heim (University of Zurich, Switzerland) “Robot-assisted neurorehabilitation for children: rationale, clinical implementation”
11:40  Pr S. Laureys (ULg) “Consciousness & communication after coma”

Third Session - Posters - Chairs: Evert Thiery, Geert Verheyden & Yves Vandermeeren
12:20  Posters oral presentation
13:00  Lunch - posters and sponsors exhibition

Fourth Session - Chairs: Evert Thiery & Gaëtan Stoquart
14:20  Prs P. Santens and M. De Letter (UGent) “Neuropsychologic registration as an aid to aphasia rehabilitation”
15:00  Pr Y. Vandermeeren (UCL - CHU Dinant Godinne) “Neuromodulation close at hand for neuro-rehabilitation”
15:40  Satellite symposium: Presentation of the post-rehabilitation project “To Walk Again” (Tongerlo): testimony of a patient and demonstration of an exoskeleton
16:20  Conclusion
16:25  Closing cocktail
KEYNOTE LECTURE

Professor Thierry Lejeune, MD, PhD

The challenge of new technologies in neurorehabilitation

This talk will provide a general introduction to the development and use of new technologies in medicine, and in particular in neurorehabilitation. The challenge of these new technologies will be presented and discussed. Why to develop it, why to use it, to which patients prescribe it, and how to improve it? In particular, the robotic assisted upper limb rehabilitation will served as an example for this introduction.

Thierry Lejeune is specialist in physical medicine and rehabilitation. He is Head of the Physical Medicine and Rehabilitation Department of the Cliniques universitaires Saint-Luc. He is professor with the Faculté des sciences de la motricité and with the Institute of Experimental and Clinical Research of Université catholique de Louvain, and member of the management committee of the Louvain Bionics.
KEYNOTE LECTURE

Dr Darryl Charles, BEng, MSc, PGCE, PhD

Games and Virtual Reality for Stroke Rehabilitation

Abstract: Research has shown that a high intensity of rehabilitation is important for stroke survivors. To this end it is important that stroke survivors are able engage in regular early center based rehabilitation and continue their rehabilitation in the home. An obstacle to achieving this goal is limited access to physiotherapy and without this directed clinical support the level and quality rehabilitation is often reduced. Virtual reality computer based systems have the potential to supplement center based physiotherapy by providing personalized, guided exercises, which can be enhanced by designing and constructing games around core user motion. Games can help motivate more regular and intensive rehabilitation exercise while modern tracking systems can monitor and provide feedback and guidance on the quality of movement. This lecture will provide an overview of research by the team at Ulster into the use of VR and games for stroke rehabilitation over the past 10-15 years, discussing some of the key issues and opportunities, and concluding with a discussion on potential future directions for the area.

Darryl Charles is Senior Lecturer in the Faculty of Computing & Engineering and a member of the Computer Science Research Institute at Ulster University, Northern Ireland.

Darryl Charles graduated with a BEng Electrical and Electronic Engineering from Queens University Belfast in 1988. Subsequently he attained an MSc in Microelectronics and Microcomputer Applications from the University of Ulster in 1995. He completed his PhD in unsupervised neural networks in 1999 at the University of Paisley where also held a faculty post as a Senior Lecturer between 1996 and 2001 before moving to Ulster. His research over the past twenty years has covered areas such as gamification, machine learning, computational intelligence and games, connected health, serious games, game based learning, intelligent interactive digital storytelling, and player profiling and modelling. He has around 100 peer reviewed papers and book publications across these areas. His recent research has been mainly focused on health technology and rehabilitation.
KEYNOTE LECTURE

Professor Martin Edwards, PhD

The use of new technology for diagnosis and rehabilitation in perception and action

The purpose of my presentation will be to discuss three new technologies that can be used for the diagnosis and rehabilitation of perception and action deficits following brain damage. In the first part of the talk, I will discuss the use of eye-tracking technology for the diagnosis of simultanagnosia and hemineglect attention deficits. I will then continue with the theme of hemineglect diagnosis, and introduce a new robotic diagnosis measure for hemineglect. Within this part of the presentation, I will focus on the diagnosis of motor hemineglect and I will discuss possible relations to hemiparesis. I will then complete the presentation by discussing the use of robots and virtual reality for hemineglect treatment, and I will conclude with a statement about the future value of technology for neuropsychology diagnosis and rehabilitation.

Martin Edwards is a research neuropsychologist interested in better understanding the relationships and neural processes involved in perception and action behavior, and developing new measures and treatment exercises using new technology. He obtained a PhD in neuropsychology in 1999 from the University of Birmingham, UK. He then completed 3 years of post-doc, and 8 years of teaching at the Universities of Exeter and Birmingham (UK). He has worked at the Université catholique de Louvain since 2010, where he is now a professor with the Faculté de psychologie et des sciences de l’éducation, the Psychological Sciences Research Institute and the Institute of Neuroscience. He is also member of the management committee of the Louvain Bionics.
KEYNOTE LECTURE

Professor Andreas Meyer-Heim, Paediatrician, MD, Priv. Doz.

Robot-assisted neurorehabilitation for children: Rationale, clinical implementation

In recent years technological developments have increasingly entered the field of paediatric neuro-rehabilitation. Rehabilitation robotics and computer-assisted systems can complement conventional physiotherapeutic or occupational therapies.

These systems seem promising, especially in children, where exciting and challenging virtual reality scenarios could increase motivation to train intensely in a playful therapeutic environment.

Despite promising experiences and a large acceptance by the patients and their parents, so far only a few therapy systems have been evaluated in children and well-designed randomized controlled studies in this field are still lacking.

This lecture aims to provide an overview about to-date robot-assisted and computer-based therapies and the current level of evidence. The author would like to share his current experience about the clinical implication and some future-oriented thoughts about these new technologies made available for children.

Andreas Meyer Heim is the Chief medical officer of the Rehabilitation Centre Affoltern am Albis and Division of Rehabilitation at the University Children’s Hospital in Zurich, Switzerland. He is a Dr. of Medicine (MD), Pediatrician and PD (private lecturer) at the University of Zurich in the field of Peadiatric Rehabilitation and associated lecturer at the Zurich University of Applied Sciences (ZHaW).

He is president of the Swiss Academy of Childhood Disability (SACD), past board member of the Swiss Society of NeuroRehabilitation (SGNR), board member and group leader at the Neuroscience Centre Zurich (ZNZ), member of the Rehabilitation Initiative & Technology Platform Zurich (RITZ) and joint member in the Clinical Research Priority Program (CRPP): Neuro-rehabilitation: strategies for customized Treatments of the University Zurich.

Dr. Meyer-Heim focuses on novel therapeutic approaches for sensory-motor learning in children with CNS disabilities. He is interested in the development, clinical application and research of effectiveness of a variety of therapies in pediatric rehabilitation especially robot-assisted and computer-based methods.
KEYNOTE LECTURE

Professor Steven Laureys, MD, PhD

Consciousness & communication after coma

The past 15 years have provided an unprecedented collection of discoveries that bear upon our scientific understanding of recovery of consciousness in the human brain following severe brain damage. When patients in “persistent vegetative state” (recently coined unresponsive wakefulness syndrome) show minimal signs of consciousness but are unable to reliably communicate the term minimally responsive or minimally conscious state (MCS) is used. MCS was recently subcategorized based on the complexity of patients’ behaviors: MCS+ describes high-level behavioral responses (i.e., command following, intelligible verbalizations or non-functional communication) and MCS- describes low-level behavioral responses (i.e., visual pursuit, localization of noxious stimulation or contingent behavior such as appropriate smiling or crying to emotional stimuli). Patients who show non-behavioral evidence of consciousness or communication only measurable via ancillary testing (i.e., functional MRI, positron emission tomography, EEG or evoked potentials) can be considered to be in a functional locked-in syndrome.

Steven Laureys is the founding director of the Coma Science Group at the GIGA Research and Neurology Department of the University and University Hospital of Liège, Belgium. He is Research Director at the Belgian National Fund for Scientific Research and board-certified in neurology and in palliative medicine. He is President Elect of the Association for the Scientific Study of Consciousness and Chair of the World Federation of Neurology Applied Research Group on Coma. His team studies acquired brain injury and altered states of consciousness confronting clinical expertise and bedside behavioral evaluation with neuroimaging and electrophysiology, also dealing with the ethical implications of this translational clinical research.
Neurophysiologic registration as an aid to aphasia rehabilitation

Aphasia is common in left-hemispheric lesions. Its presentation is extremely varied and prognosis is dependent on a number of variables. Aphasia rehabilitation requires the clinical skills for diagnosis, monitoring and follow-up of language abilities, taking into account the principles of plastic reorganization of linguistic functions. Neurophysiological testing can be an aid to behavioural rehabilitation by the demonstration of correlations of evoked potential measurements with linguistic test results. For this purpose we developed normative electrophysiological data for phonological and lexical tests and we are in the process of setting up a database for semantic and syntactical processing. The potential of electrophysiological registration is demonstrated in case of a high-functioning aphasic patient.

In addition, a short illustration is given for the potential of intra-operative stimulation during awake surgery for gliomas in cortical language areas, which is used for the prevention of post-operative aphasia.

Patrick Santens is a neurologist at the Ghent University Hospital and Full Professor at the Ghent University. He is in charge of the movement disorders unit at the Department of Neurology. His research interests are broad, including the neurophysiology of movement and cognition and especially speech and language. He has authored and co-authored over 100 peer-reviewed international papers.

Miet De Letter is a Master in Speech Language Pathology and Assistant Professor at the Ghent University. She has extensive experience in the diagnosis and treatment of speech and language disorders in acute and chronic neurological disorders. Her research interests mainly focus on the neurophysiology of speech and language in normal as well as in pathological conditions. She is currently holder of a Research Tenure Track position at the Ghent University.
Virtualy, any disorder of the nervous system is accompanied by / results in / is caused by abnormal neuronal activity or excitability. Abnormal neural activity might be more than a bio-marker of disease progression; it might be considered as a therapeutic target. Nowadays, the question is not whether we can modulate purposefully neural activity but how we should do it. Beyond the physiological modulation of neurotransmission occurring “spontaneously”, neuromodulation is defined as the alteration of neural activity through the delivery of pharmaceutical agents, electrical signals, or other forms of energy to targeted sites of the body. We have (too?) many methods to apply therapeutic neuromodulation, ranging from invasive (surgically implanted devices) to non-invasive (transcranial / peripheral nerve stimulations, phototherapy, neuro-feedback, etc...), from neurochemical (drugs) to electro-magnetic. It is conceivable that, in a few years, most sessions of neurorehabilitation will be coupled with targeted neuromodulation.

Yves Vandermeeren is a Neurologist involved in the care of acute and chronic stroke patients and in the study of neuroplasticity after stroke.

He obtained is M.D. degree at the Université catholique de Louvain (UCL, Belgium, 1998), and his Ph.D. in Neuroscience in the Laboratory of Neurophysiology (UCL, 2003). After Neurology residency, he pursued his research on post-stroke plasticity as a Post-Doc Fellow at the NIH (National Institute of Health, Maryland, US, 2005-2007).

In 2007, he joined the team of Pr. Laloux in the CHU UCL Namur, where he works half-time as a stroke neurologist and half-time as a neuroscientist. He has been appointed Associate Professor in 2009 (UCL), and Professor in 2015. He is an active member of the Institute of NeuroScience (IoNS, UCL) and the Louvain Bionics.

He is one of the founding members of the Belgian Society for NeuroRehabilitation (BSNR), and a board member of the BSNR. He is also a member of the Scientific Board of the Belgian Stroke Council (BSC) since 2008; he served as President of the Scientific Board of the BSC from 2009 to 2013.

His main research topics are the study of the motor system’s plasticity with functional magnetic resonance imaging (fMRI) and developing new ways to enhance post-stroke motor recovery based on motor learning principles, the use of neuromodulation such as non-invasive brain stimulations, and robotics.
ACTION OBSERVATION AND IMAGINATION TO REDUCE HEMINEGLECT: A MULTIPLE-CASE STUDY

V. Montedoro¹, S. Grade¹, F. Coyette², C. Prairial², A. Ivanoiu³,⁴ & M.Edwards¹,⁴
¹Université catholique de Louvain, Psychological Sciences Research Institute, Belgium
²Cliniques universitaires Saint-Luc, Centre de revalidation neuropsychologique, Belgium
³Université catholique de Louvain, Institute of Neuroscience, Belgium
⁴Cliniques universitaires Saint-Luc, Neurology Department, Belgium

Abstract

Keywords: Hemineglect; Rehabilitation; Mirror neurons.

Hemineglect causes difficulties to perceive objects in contralesional space which significantly hinders functional daily activities [1]. Treatments exist but none are entirely effective [4]. This study assessed the efficacy of a new rehabilitation method based on Mirror Neuron System theory and the finding that hemineglect patients are able to execute actions without spatial bias [2, 3]. Here we aimed to prime attention and reduce hemineglect through combined action observation and imagination. We tested five case-patients with left hemineglect using a double-baseline and counterbalanced manipulation design. The experimental manipulation consisted of forty first-person perspective movie clips of daily actions starting in the centre and moving to the contralesional hemifield. The control condition featured the same movie clips, but flipped so that actions were made to the ipsilesional hemifield. Each movie was followed by a white screen during which the patients imagined the previously observed actions. The study lasted for three weeks, with five repeated measures of hemineglect severity across the period. Results were analysed using case analyses, which showed that all patients presented a reduction in hemineglect on at least one measure following the experimental compared to control manipulation. Moreover, the patients suffering the most from hemineglect in daily life showed the greater benefits from the rehabilitation. The results will be discussed in terms of follow-up studies that use robot evaluation of pre and post treatment changes, for different types of hemineglect.

References

ELECTRICAL STIMULATION OF THE WALL OF A PATHOLOGIC BRAIN CAVITY IN THE MOTOR CORTEX IN RATS

F. Ceyssens1, M. Deprez2, I. Nica3, K. van Kuyck K2, JM. Aerts3, B. Nuttin2, R. Puers1
1KU Leuven, Research Group ESAT-Micro-Electronics and Sensors, Leuven, Belgium
2KU Leuven, Research Group Experimental Neurosurgery and Neuroanatomy, Leuven, Belgium
3KU Leuven, Research Group Animal and Human Health Engineering, Leuven, Belgium

Abstract
Keyword(s): deep brain stimulation, LFP, pathologic brain cavity, motor cortex

1.1 Introduction
Pathologic brain cavities, often caused by e.g. stroke, are associated with disrupted neural circuitries. Symptoms are caused not only by the loss of neurons, but also by the disruption of neural networks. Since deep brain stimulation (DBS) emerged as a last-resort treatment for patients with Parkinson’s disease [1], it has been implemented for many indications [2-4]. We now propose an entirely new and unexplored application where electrode contacts are implanted directly against the wall of a pathologic brain cavity. This approach allows us to interact directly with the neurons of the disrupted circuitries by listening to their electrical activity (by recording local field potentials, LFPs) and by electrically stimulating them.

1.2 Methods
We developed miniature thin-film electrode arrays consisting of a matrix of 16 or 38 platinum contacts, designed to be flexible enough to conform to the pathological brain cavity wall. We implanted these electrodes against the wall of a pathologic brain cavity in the primary motor cortex of 20 rats. We recorded LFPs with all electrode contacts from the cavity wall while rats were performing behavioral tests. In a second stage, we electrically stimulated the cavity wall thereby aiming to improve the motor symptoms. Rats were tested with several sets of stimulation parameters (cathodic biphasic stimulation with all contacts, 100 Hz, 210 µs) in a randomized and blinded crossover experiment.

1.3 Results
Based on spectral feature exploration, we obtained strong evidence that the theta power band (6-10 Hz) and the gamma band (45-90 Hz) are correlated to an active, engaged movement state. In all animals, electrical stimulation of the cavity wall at supra-optimal amplitudes induced visible side effects, such as clonic behavior and seizures. Furthermore, this behavior was often limited to the lesioned limb only. No improvement of motor function at the optimal amplitude was observed.

1.4 Conclusion
Some frequency bands were correlated to movement of the rat, confirming results in healthy rats and other studies exploring the sensorimotor cortex and hippocampus. In the future, we aim to use LFPs to guide us to the best place for stimulation, or for driving a closed-loop stimulation algorithm.

References
MATURATION OF VISUOSPATIAL ATTENTION IN TYPICALLY DEVELOPING CHILDREN

G. Ickx1, Y. Bleyenheuft 1, S. M. Hatem1, 2, 3
1Institute of Neuroscience, Université Catholique de Louvain Brussels, Belgium.
2Physical Medicine and Rehabilitation, Brugmann University Hospital Brussels, Belgium
3Faculty of Physical education and Physiotherapy, Vrije Universiteit Brussel

Abstract

Background: Visuospatial neglect is a common and well documented condition following brain lesion. Over the past decades, several tests have been developed for diagnostic use in adult subjects and subsequently applied for research purposes. Though children with brain lesions are likely to develop visuospatial attention deficits, the ontogenesis of diagnostic tests for visuospatial neglect developed for adult subjects has never been studied and normative data for children are not available till now. Visuospatial attention has attracted increasing interest in different pediatric pathologies such as attention-deficit-hyperactivity disorder and cerebral palsy. Therefore, normative values are needed in typically developing children.

Aim: The aim of the present study was to investigate the ontogenesis of visuospatial attention in typically developing children and to create normative values for children in six tests used to diagnose visuospatial neglect: star cancellation, Ogden figure, reading test, line bisection, proprioceptive pointing and visuo-proprioceptive pointing.

Method: A hundred and thirty-four typically developing children between 4 and 19 years old from 4 different schools of the Fédération Wallonie Bruxelles participated in this study.

Results: The results showed that the performance on star cancellation, Ogden figure and reading test improved until the age of 10 whereas performance on the proprioceptive pointing, visuo-proprioceptive pointing and line bisection did not appear to evolve with age.

Conclusion: These data suggest that different neural networks with different maturation velocities could be required to perform different types of visuospatial tasks. In future research, the described normative values could be used to study visuospatial deficits in children with pathological conditions.
VISUOSPATIAL ATTENTION DEFICITS IN CHILDREN WITH UNILATERAL CEREBRAL PALSY

G. Ickx¹, I. Riquelme², C. Henne³, A. M. Gordon⁴, S. M. Hatem¹, ³, ⁵, Y. Bleyenheuft¹

¹Institute of Neuroscience, Université Catholique de Louvain Brussels, Belgium.
²Research Institute on Health Sciences; Department of Nursing and Physiotherapy University of Balearic Islands Palma de Mallorca, Spain
³Brugmann University Hospital Brussels, Belgium
⁴Teachers College, Columbia University, New York, NY, USA.
⁵Faculty of Physical education and Physiotherapy, Vrije Universiteit Brussel

Abstract

Background: Cerebral palsy occurs in 2 to 3.6 out of 1000 children. Various motor impairments may be observed, depending on the timing, extent and location of the lesions and the subsequent reorganization of the descending motor pathways. While the disorders are characterized as mainly motor, some associated symptoms may be present, including somatosensory symptoms. The role of sensory abilities is mainly to provide feedback in order to optimize motor learning and control. In children with CP, sensory feedback is largely abnormal, and thus vision plays a crucial role for compensation during motor control and learning new motor behaviours, i.e., new functional motor abilities. However, visual feedback may be difficult to interpret and/or to integrate due to problems of visual attention to the paretic hemibody. Visuospatial attention is seldomly studied in children with unilateral cerebral palsy (UCP). A better understanding of visuospatial attention deficits in children with UCP may lead to the adaptation of rehabilitation tools according to these deficits.

Aim: The aim of the present study was to assess the prevalence of visuospatial attention deficits in children with UCP.

Method: Eighty-five children with UCP were assessed with six tests; a star cancellation test, an Ogden figure copy, a reading test, a line bisection test, a proprioceptive test and a visuo-proprioceptive test. Results: 75% of children with UCP presented a deficit in at least one test compared to typically developing (TD) children.

Conclusion: In our sample, the majority of children with UCP (75%) presented with a deficit of visuospatial attention compared to TD controls. The present results shed new light on the interpretation of motor impairments in children with UCP.
UPPER LIMB STIFFNESS ASSESSMENT USING REAPLAN IN STROKE PATIENTS

S. Dehem¹,2, M. Gilliaux¹,2, T. Lejeune¹,2, C. Detrembleur¹,2, J. Sapin³,4, B. Dehez³,4, G. Stoquart¹,2,3
¹Institute of Experimental and Clinical Research, Brussels, Belgium
²Cliniques universitaires Saint-Luc, Brussels, Belgium
³Louvain Bionics, Université catholique de Louvain, Louvain-la-Neuve, Belgium
⁴Institute of Mechanics, Materials and Civil Engineering, Université catholique de Louvain, Louvain-la-Neuve, Belgium

Abstract
Keywords: stroke rehabilitation, stiffness assessment, robotic, upper limb.

1. OBJECTIVE
To quantify upper limb stiffness in spastic patients using REAplan, a robotic device used in rehabilitation that can mobilize the patient’s upper limb in a horizontal plane.

2. PATIENTS
Twelve chronic stroke patients with hemiplegia were recruited. Elbow flexor muscles spasticity was assessed with Modified Ashworth Scale (MAS), with a score greater than 1.

3. METHODS
Patients received an anaesthetic block of the musculo-cutaneous nerve, to reduce elbow flexor muscles spasticity. Each patient was assessed before and after the injection of the anaesthetic block and also the next day. Each time, stiffness was measured with the REAplan. The robot passively mobilized the patient’s upper limb at various speeds (10, 20, 30, 40 and 50 cm/s) in a back-and-forth trajectory (30 cm). For each speed condition, ten movements were performed. We recorded the force required to passively mobilize the patient’s upper limb. For the ten extension movements, stiffness were analyzed and averaged.

4. RESULTS
The results showed that the stiffness increased proportionally with the speed condition (p<0.001). For the anaesthetic effect, the results showed that the stiffness decreased just after the injection at 40 and 50 cm/s and increased until the initial values the next day (p<0.05). Finally, the stiffness results showed a good correlation with the MAS, for each speed condition greater than 20 cm/s (r>0.6).

5. CONCLUSIONS
This study develops and validates a protocol to quantify the upper limb stiffness, using the robot REAplan. This protocol, must be compared to other quantitative measures of spasticity in the future, and could be used to assess the effect of spasticity treatments (e.g. botulinum toxin).
NORDIC WALKING CAN IMPROVE DYNAMIC STABILITY OF HUMAN GAIT IN PARKINSON’S DISEASE

Th. Warlop1,2, Ch. Detrembleur2,3, G. Stoquart1,2,3, B. Bollens1, A. Jeanjean4,5, Th. Lejeune1,2,3

1 Physical and Rehabilitation Medicine Department, Cliniques universitaires Saint-Luc, Belgium
2 Université catholique de Louvain, Institut de Recherche Expérimentale et Clinique (IREC), Belgium
3 Université catholique de Louvain, Louvain Bionics, Belgium
4 Université catholique de Louvain, Institute of Neurosciences (IoNS), Belgium
5 Neurology Department, Cliniques universitaires Saint-Luc, Belgium

1. INTRODUCTION
Activating the upper body during walking, Nordic walking (NW) may be used as an external cueing to improve spatiotemporal parameters of gait, such as stride length or gait variability, in Parkinson disease (PD) [2]. Structured gait variability, revealed by the presence of long-range autocorrelations (LRA), was associated to dynamic stability of gait [1]. This study aimed to study beneficial effects of NW on dynamic stability of gait and spatiotemporal gait parameters in PD.

2. METHODS
Fourteen mild to moderate PD patients performed 2×12min overground walking sessions (with and without pole in a randomized order) at a comfortable speed. Gait speed, cadence, step length and temporal organization (i.e. LRA) of stride duration variability were studied on 512 consecutive gait cycles using a unidimensional accelerometer placed on the malleola of the most affected side. The presence of LRA was determined using the Rescaled Range Analysis (Hurst exponent) and the power spectral density (α exponent). To assess NW influence on PD gait, a paired t-test was used.

3. RESULTS
All patients presented LRA during both walking sessions. However, Hurst and α exponents were significantly higher during NW (p<0.001 and p=0.003, for Hurst and α exponents, respectively). While gait speed remained unchanged between two walking sessions, gait cadence decreased (p<0.001) and step length increased significantly (p<0.001).

4. DISCUSSION AND CONCLUSION
This study demonstrates that Nordic walking can improve the dynamic stability of gait in PD. Involving a voluntary intersegmental coordination, such improvement could also be due to the upper body rhythmic movements acting as rhythmical external cue to bypass their defective basal ganglia circuitries. Therefore, Nordic walking may constitute a powerful way to manage gait disorders in PD.

Keyword(s): Gait variability, Spatiotemporal gait parameters, Interlimb coordination

References
1. INTRODUCTION
Timing gait disorders of Parkinson’s disease (PD) are characterized by unstructured gait variability. Recently, the breakdown of the temporal organization of stride duration variability (i.e. long-range autocorrelations; LRA) was associated to dynamic instability in PD. To improve timing gait in PD, synchronization of walking with rhythmic auditory stimulation (RAS) like music or metronome is largely used in clinical settings. However, while structure of RAS can modulate LRA in healthy gait pattern [1], it remains unknown in PD.

2. METHODS
Nine patients performed overground walking trials at a comfortable speed while listening different structures of RAS (counterbalanced order across patients): isochronic, randomly fluctuating, fluctuating according to an LRA structure and no RAS. Each structure was adapted to the patient’s gait cadence as previously measured in a 10 meter-walking test. Temporal organization (LRA) of stride duration variability, gait cadence, speed and stride length were measured on 512 consecutive gait cycles. The presence of LRA was based on scaling properties of the series variability (Hurst exponent) and the shape of the power spectral density (α exponent). Those measures were compared across the four conditions using a one-way-repeated ANOVA.

3. RESULTS
Our results show that temporal organization of PD gait may be modulated using different auditory structures. Adequate correlation between LRA of gait and auditory cue indicates strong adaptation and synchronization of the gait to the RAS. However, LRA were systematically lower during auditory conditions compared to spontaneous walking session, up to the disappearance of LRA during isochronic RAS. Furthermore, gait cadence, speed and stride length were not statistically different across different conditions.

4. DISCUSSION AND CONCLUSION
Isochronic auditory stimuli (e.g. metronome) do not seem to be an optimal way to improve timing gait in PD, as it induces the disappearance of LRA. Future work will investigate whether structured auditory stimuli induce gait improvement in PD.

Keyword(s): Gait variability, Rhythmic auditory stimulation, Cueing

References
EFFECT OF ROBOTIC GAIT REHABILITATION ON BIOMECHANICAL PARAMETERS IN CHILDREN WITH CEREBRAL PALSY

L. Wallard¹, G. Dietrich², Y. Kerlirzin², J. Bredin³,⁴

¹ Institut de Recherche Expérimentale et Clinique, Université Catholique de Louvain, Belgique
² Laboratoire Education Discours Apprentissages EA4071, Centre Universitaire des Sants-Pères, France
³ Centre de Santé - Institut Rossetti-PEP06, Unité Clinique d’Analyse du Mouvement, 400, France
⁴ Laboratoire Motricité Humaine Éducation Sport Santé EA6312, Faculté des Sciences du Sport, Université Nice-Sophia Antipolis, France

Keywords: Cerebral palsy; Clinical gait analysis; Robotic gait rehabilitation; Balance control.

1. Introduction
Children with cerebral palsy (CP) often have atypical body posture patterns and abnormal gait patterns causing activity limitation. The gait is generally characterized by a set of persistent movement and posture disorders [1], resulting in strong postural instability and rigidity of the whole body particularly of its upper part [2-5]. Therefore, the acquisition of new locomotor capacities represents one of the primary care objectives of these children by optimizing available therapeutic treatments. In recent years, robot-assisted gait training as the Lokomat® (Hocoma, Switzerland) was introduced in pediatric rehabilitation. This type of rehabilitation aims to allow children with CP to regain a maximum of functional independence (mobility, self-care, social integration, etc.). The aim of this study is to highlight the effects of robotic gait rehabilitation on balance control in gait children with CP.

2. Materials and methods
Clinical gait analysis (Vicon® - Oxford Metrics, Oxford, UK) was performed from 30 children with spastic diplegia: 14 children receiving twenty sessions of Lokomat® Pediatric program (4 intensive sessions of 30 minutes per week during 5 weeks) and 16 children without sessions.

3. Results
The results show a significant improvement i) in locomotor parameters (speed, cadence, length and width step, etc.) ii) in kinematic (mainly in the upper limb) and kinetic data (correlation coefficient between the COM/COP trajectory and the propulsive forces generated).

4. Discussion
This study allows to show modification of the balance control in gait children with CP. Indeed, the analysis of the locomotor parameters shows that children belonging to the Lokomat® group were seen to adopt new gait strategies compared to the Control group. The kinetic and kinematic data confirm the locomotor parameters data. Indeed, we observed, for example, for the Lokomat® group overall a normalization of the forward propulsive forces production underlying the quality of the dynamic stability in gait but also a much better upper limb control (trunk and head). These children seem to adopt new dynamic strategies of gait.

References
CHANGES IN TACTILE FUNCTION DURING INTENSIVE BIMANUAL TRAINING IN CHILDREN WITH UNILATERAL CEREBRAL PALSY

G. Saussez¹, M. Van Laethem², Y Bleyenheuft¹

¹Université catholique de Louvain, Institute of NeuroSciences, Belgium
²Université catholique de Louvain, Faculté des Sciences de la Motricité, Belgium

Keywords: [cerebral palsy; tactile function; bimanual training; intensive intervention; enriched environment]

1. BACKGROUND
In addition to motor function impairments, tactile function is often impaired in children with unilateral cerebral palsy (UCP) [1]. Intensive interventions have shown the ability to improve motor function in children with UCP. A recent study used specific material to enrich tactile environment during an intensive bimanual intervention with and without vision and showed improvements in tactile spatial discrimination and a trend in stereognosis in both groups [2]. It is still unknown if these improvements are due to intensive bimanual training itself or the enriched environment.

2. AIM
This study investigate if intensive bimanual training alone is sufficient to improve tactile function in children with UCP or if it is needed to add specific material to enrich the tactile environment.

3. METHOD
Nineteen children with UCP received 90 hours of intensive bimanual training without specific material (not-enriched environment) for ten consecutive weekday (9 hours/day). Primary tactile function outcomes included tactile spatial discrimination (grating orientation task) and stereognosis (manual form perception test). Secondary motor outcomes included the box and blocks test (BBT) and the Jebsen-Taylor test of hand function (JTTHF). Children were assessed at pre-camp, post-camp and 4 months follow-up.

4. RESULTS
Stereognosis significantly improved on the more-affected hand between pre-camp and follow-up assessment’s sessions but not on the less-affected hand. No improvement was observed for the GOT. Significant improvements were noticed on the more- and the less-affected hand for the BBT and only on the less-affected hand for the JTTHF after intensive bimanual intervention.

5. CONCLUSION
Intensive bimanual training without enriched tactile environment is sufficient to improve stereognosis on the more-affected hand, probably because of the motor component of the test but not to improve tactile spatial discrimination. This suggests the addition of specific material (various textures, shapes, sizes,...) to enrich the environment is needed to improve tactile function in children with UCP during intensive interventions.

6. REFERENCES
GRASP CONTROL IN CHILDREN WITH CONGENITAL HEMIPLEGIA IN A DISCRETE MOTOR TASK OF INTERSEGMENTAL COORDINATION

D. Ebner Karestin1*, B. Flament2*, C. Arnould2, J.L. Thonnard1, 3, Y. Bleyenheuft1

1Université catholique de Louvain, Institute of NeuroSciences, Belgium
2Haute Ecole Louvain en Hainaut, Physical and Occupational Therapy Department, Charleroi, Belgium
3Cliniques Universitaires Saint-Luc, Physical and Rehabilitation Medicine Department, Brussels, Belgium

*Both authors contributed equally to this study.

Keywords: Intersegmental Coordination, Grip Force, Load Force, Cerebral Palsy, Motor Control.

1. BACKGROUND
Precision grasping relies on predictive and reactive mechanisms, both affected in children with unilateral cerebral palsy (UCP). To avoid slips/early fatigue, a good coordination between grip (GF) and load (LF) forces is required. This coordination has never been studied in a daily/functional activity such as stepping down while carrying an object, where the intersegmental upper/lower extremity coordination is needed.

2. AIM
To compare the GF-LF synchronization during the step-down task in children with UCP with typically developing children (TDC).

3. METHOD
Participants were 21 children with UCP and 21 age-matched TDC. Standing on a step and holding a grip-lift manipulandum (GLM), the children were instructed to go down a step spontaneously and maintain subsequently a static ending position. The GLM provided LF and GF measures.

4. RESULTS
Children with UCP had higher values of GFmax, LFmax and LFmax variability in both hands than TDC and higher values of LFmax on the paretic hand vs the non-paretic. Temporal analysis showed a longer anticipatory delay (LFmin→LFmax) in both hands of children with UCP. We observed a correlation between LFmax and GF at LFmax in the non-paretic hand of children with UCP and in both hands of TDC, but not in the paretic hand.

5. CONCLUSIONS
Children with UCP showed impairments for dynamics in both hands. The grip/lift coupling was altered only in their paretic hand. These findings highlight a global motor planning deficit in both upper extremities, and impairment in sensory motor integration solely focused in the paretic hand during this intersegmental task.
UNILATERAL CEREBRAL PALSY IS NOT ALWAYS THE MILDEST TYPE OF CEREBRAL PALSY IN DAILY LIFE ACTIVITIES

J. Paradis¹, C. Arnould², Y. Bleyenheuft¹

¹Institute of NeuroSciences, Université catholique de Louvain, Belgium
²Physical and Occupational Therapy Department, Paramedical Category, Haute Ecole Louvain en Hainaut, Montignies-sur-Sambre, Belgium

Keywords: cerebral palsy, daily life activities, performance, questionnaires

Background: it is frequently assumed that children with unilateral cerebral palsy (UCP) have better functional abilities in daily life than children with bilateral CP.

Aim: to investigate the functional abilities differences between CP topographical distributions (i.e. UCP, diplegia, quadriplegia) and to study whether children with UCP have better functional abilities than children with bilateral CP.

Method: this is a retrospective study investigating 30 items removed from the validation study of the ACTIVLIM-CP, a new questionnaire measuring activity level (upper, lower extremity and combination of both), because their difficulty varied significantly depending on topographical distribution. For each item, 16 experts were asked to classify the type of the daily activity as: locomotor, bimanual, intersegmental upper/lower extremities (UE/LE). Within each activity type, activity difficulty variations observed across topographical distributions were analysed to highlight topographical-specific functioning patterns.

Results: children with UCP were significantly less able to perform bimanual activities compared to children with bilateral CP but were significantly more able to perform locomotor activities. For intersegmental UE/LE activities with a predominant implication of LE (locomotion and/or trunk in movement) we observed the same pattern as in locomotor activities. For intersegmental UE/LE activities with a predominant implication of UE (bimanual and antigravity posture) we observed mainly the same pattern as in bimanual activities.

Conclusion: bimanual and intersegmental activities with a predominant implication of UE were perceived as more difficult to be achieved for children with UCP. These findings are of clinical interest in breaking the general assumption about the mild aspect of UCP and in planning more relevant and precise functional objectives in rehabilitation.
ACCEPTANCE AND SATISFACTION OF ORTHOTIC DEVICES FOR THE LOWER LIMB IN MULTIPLE SCLEROSIS AND STROKE PATIENTS

E. Swinnen\textsuperscript{1,2,3,7}, Y. Gesthuizen\textsuperscript{1}, L. Ceulemans\textsuperscript{1}, S. Christiaens\textsuperscript{1}, L. De Wael\textsuperscript{1}, S. Ilsbroukx\textsuperscript{4}, J. Van Nieuwenhoven\textsuperscript{4}, M. Michielsen\textsuperscript{5}, C. Lafosse\textsuperscript{6}, N. Lefeber\textsuperscript{1,2,7}, E. Kerckhofs\textsuperscript{1,2,7}

\textsuperscript{1}Faculty of Physical Education and Physiotherapy, Rehabilitation Research, Vrije Universiteit Brussel, Brussels, Belgium;
\textsuperscript{2}C4N, Center For Neurosciences, Vrije Universiteit Brussel, Brussels, Belgium;
\textsuperscript{3}Erasmus University College Brussels, KC Brussels Integrated Care, Brussels Belgium;
\textsuperscript{4}National Multiple Sclerosis Center, Melsbroek, Belgium;
\textsuperscript{5}Jessa hospital, Herk-de-Stad, Belgium;
\textsuperscript{6}Rehabilitation hospital RevArte, Edegem, Belgium; \textsuperscript{7}Brubotics, Vrije Universiteit Brussel, Belgium

Abstract

1. BACKGROUND
In multiple sclerosis (MS) and stroke patients an orthotic device (OD) is often used to improve the patient’s functionality. Although user-satisfaction and acceptance may partly determine the grade of adherence to an OD, little is known about the patient’s needs and expectations \cite{1}.

2. AIMS
The aim of this study was to inquire the satisfaction and reasons for acceptance of ODs for the lower limb in stroke and MS patients. Additionally, differences between the male and female patients were analyzed.

3. METHODS
Adult post-stroke and MS patients who had at least one prescribed OD for the lower limb were included. Two questionnaires were used: an ad hoc constructed questionnaire measuring the reasons for acceptance (MIRAD-ACCORT II questionnaire) and a modified version of the D-QUEST 2.0 measuring user-satisfaction \cite{2}. Descriptive analyses of the data were performed. Chi\textsuperscript{2} tests and Mann-Whitney U tests were used to compare the data of the male and female patients (SPSS 22).

4. RESULTS
26 post-stroke and 23 MS patients participated (38 with a prescribed AFO, 6 with a KAFO and 5 with a knee brace). The patients were satisfied to very satisfied with their OD, and reported “safety”, “ease of use”, “effectiveness”, and “comfort” as most important aspects. There were no significant differences between the sexes.

5. CONCLUSION
In general, post-stroke and MS patients were quite satisfied with their OD, and aspects related to effectiveness and comfort were reported as more important than the esthetical aspects. These results could contribute to the process of design, construction and provision of an OD.

Keyword(s): Stroke, Multiple Sclerosis, Satisfaction, Acceptation, Orthotic devices

References
HOW TO ASSESS THE LEVEL OF PERCEIVED FATIGUE AMONG PATIENTS WITH MULTIPLE SCLEROSIS?

M. Valet\textsuperscript{1,2}, G. Stoquart\textsuperscript{1,2}, T. Lejeune\textsuperscript{1,2}

\textsuperscript{1}Institut de Recherche Expérimentale et Clinique (IREC), Pôle CARS, Université catholique de Louvain, 1200 Brussels, Belgium
\textsuperscript{2}Service de Médecine Physique et Réadaptation, Cliniques universitaires Saint-Luc, 1200 Brussels, Belgium

Keywords: Multiple Sclerosis, Fatigue, Assessment

BACKGROUND: Fatigue is the most frequent and disabling symptom among patients with Multiple Sclerosis (pwMS), affecting more than 80% of these patients. A lot of scales are used in clinical practice and research to assess the perceived level of fatigue.

OBJECTIVE: To analyze the clinical and psychometric properties of the self-reported fatigue assessment scales frequently used among pwMS.

METHODS: PubMed was searched for studies that investigate fatigue assessment tools in pwMS. Personal libraries, including studies regarding exercise and fatigue, were also screened. The clinical and psychometric properties of the most used tools were analyzed.

RESULTS: Fifteen tools assessing self-reported fatigue were identified. Among these tools, 3 are much more frequently used than the others: the Fatigue Severity Scale (FSS), the Modified Fatigue Impact Scale (MFIS) and the Fatigue Scale for Motor and Cognitive functions (FSMC). The 3 tools present excellent validity and reproducibility, in a similar way. Responsiveness is good for FSS and MFIS but, to date, unknown for FSMC. None of these scales fits the Rasch model, but a 5-item modified version of the FSS do. MFIS has no floor or ceiling effect, while FSS has a minor ceiling effect. It remains unknown for FSMC. The 3 scales have practical interpretability, regarding their clinical use. MFIS and FSMC have validated subscales for different domains of fatigue, while FSS has none.

CONCLUSION: The 3 most frequently used tools to assess fatigue among pwMS present very good qualities. MFIS and FSMC could distinguish between different domains of fatigue while FSS seems more appropriate to assess a change in self-reported fatigue.

References