ISVR

15th International Conference on Virtual Rehabilitation

July 23-25, 2023
Montréal, Canada

isvr.org

WCISVR 2023 Program-at-a-Glance

	23-Jul	24-Jul	25-Jul
8:00	Registration/Information Desk Open	Registration/Information Desk Open	Registration/Information Desk Open
8:30	Workshop 1 Part 1 / Workshop 2 Part 1	Keynote 2 **Dr. Elaine Biddiss**	Distinguished Service Award Talk **Dr. Mindy Levin**
8:45			
9:00			
9:15			
9:30		EC Award Talk	Fast Forward 2
9:45			
10:00	Coffee Break	Fast Forward 1	Poster Session 2 & Coffee Break
10:15			
10:30	Workshop 1 Part 2 / Workshop 2 Part 2	Poster Session 1 & Coffee Break	
10:45			
11:00			Oral Session 4
11:15			
11:30		Oral Session 2	
11:45			
12:00	Free Time		
12:15			Lunch (On Own)
12:30			
12:45		Lunch (On Own) / Mentoring Lunch (Student Only)	
13:00			
13:15			
13:30			Oral Session 5
13:45			
14:00	Welcome	Debate	
14:15			
14:30	Keynote 1 **Dr. Jennifer Campos**		
14:45			
15:00		ICDVRAT Oral Session	Demo & Coffee Break
15:15			
15:30	Coffee Break		
15:45		Coffee Break	
16:00	Oral Session 1		Oral Session 6
16:15			
16:30		Oral Session 3	
16:45			
17:00			
17:15			
17:30	Opening Reception		
17:45			Closing Remarks & AGM
18:00			
18:15		Free Time (on own)	Transition
18:30	Free Time (on own)		
18:45			Banquet (until late)
19:00			

Exhibitors Open (24-Jul)

Exhibitors Open (25-Jul)

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President's Welcome Letter

Dear participants,

It is with great excitement that we extend a warm welcome to the World Conference of the International Society for Virtual Rehabilitation (WCISVR). After a hiatus of over three years, we are thrilled to announce that this conference will mark our first in-person gathering since 2019, in Tel Aviv.

As the world gradually emerges from the challenges posed by the global pandemic, we find ourselves at a moment where the significance of virtual rehabilitation has been further underscored. The advancements in this field have shown immense potential in improving the lives of individuals across various age groups and abilities. WCISVR 2023 aims to be a platform for researchers, practitioners, and industry experts to share their knowledge, exchange ideas, and forge new collaborations that will influence the future of virtual rehabilitation.

We are honored to have esteemed keynote speakers who will enlighten us with their invaluable insights. Jennifer Campos, from the Toronto Rehabilitation Institute, will deliver a presentation on her work using virtual reality to examine how older adults integrate multisensory inputs in the context of mobility. Her expertise promises to shed light on innovative approaches to enhance mobility outcomes and promote independent living in the aging population.

Elaine Biddiss, from the Bloorview Research Institute, will be our second keynote speaker. Alongside her dedicated team, Elaine is committed to creating and evaluating innovative games and apps that support young people of all abilities in achieving their goals in both recreation and rehabilitation. Her talk will provide a glimpse into the transformative potential of virtual rehabilitation for young individuals, promoting inclusivity and empowerment.

We are delighted to announce that Mindy Levin, from McGill University and recipient of the ISVR Distinguished Service Award, will also be present. Mindy's work revolves around elucidating the mechanisms underlying sensorimotor deficits and their recovery in patients with central nervous system lesions. Her expertise and contributions have had a profound impact on the field of virtual rehabilitation, and we eagerly await her insights.

In addition to the keynote presentations, the conference program will feature a diverse range of presentations, workshops, and panel discussions by leading experts from around the globe. We encourage you to actively engage in these sessions, fostering meaningful conversations and collaborations.

Montreal, with its rich history, cultural diversity, and vibrant atmosphere, offers a captivating experience for conference attendees. Explore the cobblestone streets of Old Montreal, visit the impressive Notre-Dame Basilica, and indulge in the city's renowned cuisine. Immerse yourself in the thriving arts scene, with galleries, theaters, and the Montreal Museum of Fine Arts. Nature lovers can unwind in Mount Royal Park, while the city's eclectic neighborhoods, such as the Plateau-Mont-Royal and Mile End, showcase their own unique charm.

We would like to express our deepest gratitude to all the researchers, clinicians, industry partners, and sponsors who have contributed to making WCISVR 2023 possible. Your dedication and support have been instrumental in bringing us together for this momentous event.

On behalf of the organizing committee, we extend our warmest welcome and look forward to your participation in WCISVR 2023. Let us come together to explore the frontiers of virtual rehabilitation and work towards a future where technology-driven interventions empower individuals to lead healthier, more fulfilling lives.

Bienvenue à Montréal!

Philippe Archambault, OT, PhD

Professor, McGill University
Researcher, Interdisciplinary Research Center in Rehabilitation
President, International Society on Virtual Rehabilitation

Society Information

Society Membership

The International Society for Virtual Rehabilitation has as its main purpose the encouragement of research in, education in, advocacy of, and improved collaboration between researchers, clinicians, industry and policy makers with regard to, virtual rehabilitation and tele-rehabilitation. The Society's purpose will be fulfilled through scientific meetings, tutorials, publications, postings on the Web, awards, sponsored pilot research, and other exchange of information.

Membership Term

ISVR memberships are available for a one–year term with a fixed membership year effective Oct 1 and expiring Sep 30 every year. Continuing membership requires payment of renewal dues each year.

Categories

REGULAR MEMBERSHIP

Applies to any individual with a professional degree (Bachelor's or Higher) working in research, educational, commercial, or clinical environments, and is directly or indirectly concerned with Virtual Rehabilitation and/or Tele-rehabilitation (VRT). Regular membership entitles the holder to vote in all elections.

STUDENT MEMBERSHIP

Applies to any individual with full-time student status at a recognized degree-granting institution. Student membership does not carry voting privileges.

INDIVIDUAL BENEFITS:

Being an ISVR member in good standing, entitles you to many benefits, including:

- Reduced registration fees for the World Congress of the International Society for Virtual Rehabilitation. This benefit alone more than pays for your membership fee
- Reduced registration fees for other VR conferences that have special arrangements with ISVR. Currently this includes Rehab Week, ICDVRAT, VR 4 Rehab and ICSports
- Eligibility to run for a Board position and vote in Board/Society elections (Regular members only)
- Opportunity to register for ISVR online Webinars
- Opportunity to participate in ISVR Journal Clubs
- Access to an online repository of WCISVR, ICDVRAT and Webinar talks
- Networking opportunities
- Regular Email and Social Media updates from the Society

Membership Dues

Memberships are valid from **October 1 – September 30**

- Regular – Academic/Researcher $75
- Regular – Commercial $75
- Regular – Clinician $75
- Student– $50

All fees are in US Dollars.

ISVR Leadership

Executive Officers:

President: **Philippe Archambault**, *McGill University*

Vice President: **W. Geoffrey Wright**, *Temple University*

Outgoing President: **Sergi Bermudez i Badia**, *University of Madeira*

Treasurer: **Joseph Finkelstein**, *University of Utah*

Secretary: **Danielle Levac**, *University of Montreal*

Board Member:

Marika Demers, *University of Montreal*

Anouk Lamontagne, *McGill University*

Mindy Levin, *McGill University*

Terisa Paulino, *University of Madeira*

Anjali Sivaramakrishnan, *University of Texas Health Science Center at San Antonio*

Rigina Skeva, *University of Manchester*

Sandeep Subramanian, *University of Texas Health Science Center at San Antonio*

Tamar Weiss, *University of Haifa*

Omer Weissberger, *XR Health*

Program Committee:

Conference Steering Chair:
W. Geoffrey Wright, *Temple University*

Conference Co-Chair:
Gerard Fluet, *Rutgers University*

Conference Co-Chair:
Danielle Levac, *University of Montreal*

Association Secretariat & Conference Management

Senior Association Manager: **Marischal De Armond**

Society Secretariat & Junior Conference Manager: **Vivek Punwani**

Conference Assistant: **Sebastien Lavoie**

Review Committee

Reviewer Name	Affiliation
Tal Krasovsky	*University of Haifa*
Zhu Wang	*New York University*
Rachel Kizony	*University of Haifa*
Monica Cameirao	*Universidade da Madeira*
Mohammad Al-Amri	*Cardiff University*
Iris Brunner	*Aarhus University*
Ran Yanovich	*Sheba Medical Center*
Marika Demers	*Université de Montréal*
Gerard Fluet	*Rutgers The State University of New Jersey*
Qinyin Qiu	*Rutgers University*
Desiderio Cano Porras	*Tilburg University*
Dido Green	*Jonkoping University*
Patrice (Tamar) Weiss	*University of Haifa; ALYN Hospital*
Dorra Rakia Allegue	*McGill University*
Philippe Archambault	*McGill University*
Debbie Espy	*Cleveland State University*
Marco Buhler	*McGill Univesity*
Anne Deblock-Bellamy	*University of Applied Sciences Western Switzerland*
Bronte Vollebregt	*University of Manitoba*
Naomi Gefen	*ALYN Hospital*
Anouk Lamontagne	*McGill University*
Sebastian Koenig	*Katana Simulations*
Sara Mollà-Casanova	*UBIC, University of Valencia*

Reviewer Name	Affiliation
Mark Sivak	*Northeastern University*
Jigna Patel	*Rutgers University*
Christopher Rhea	*Old Dominion University*
Bradford McFadyen	*Cirris/U. Laval*
Eva Kehayia	*McGill University*
Sujata Pradhan	*University of Washington*
Roberto Llorens	*Universitat Politècnica de València*
Sandeep Subramanian	*UT Health San Antonio*
Jason Friedman	*Tel Aviv University*
William Wright	*Temple University*
Alma Merians	*Rutgers University*
Ana Lúcia Faria	*University of Madeira*
Angelika Thoene-Otto	*University of Leipzig*
Aram Kim	*Johns Hopkins University*
Kevin Abbruzzese	*Stryker*
Maayan Agmon	*University of Haifa, Cheryl Spencer Department of Nursing*
Mindy Levin	*McGill University*
Julia Belger	*Max Planck Institute for Human Cognitive and Neurosciences*
Joyce Fung	*McGill University*
Ran Yanovich	*Sheba Medical Center*
Sebastian Koenig	*Katana Simulations*
Mark Sivak	*Northeastern University*
Suhata Pradhan	*University of Washington*
Kevin Abbruzzese	*Stryker*

Awards

Distinguished Service Award

Mindy Levin, *McGill University*

Mindy Levin is a Professor in the School of Physical and Occupational Therapy (SPOT), Faculty of Medicine and Health Sciences at McGill University in Montreal, Canada. She was Research Scholar of the Quebec Health Research Fund (1992-2004) and held a Tier 1 Canada Research Chair in Motor Recovery and Rehabilitation (2005-2019). She is currently a Distinguished James McGill Professor. She has over 200 peer-reviewed publications. Her research focuses on elucidating the mechanisms underlying sensorimotor deficits and their recovery in patients with central nervous system lesions. She has a strong background in motor control theory and the translation of motor control and motor learning principles into clinical rehabilitation applications to improve the lives of people with neurological lesions. Amongst her research methodologies are new technologies such as virtual reality and robotics.

She is currently the President of the International Society of Motor Control and is a Past-President of the International Society for Virtual Rehabilitation. She is also currently a Board member of the International Neurological Physiotherapy Association of WCPT and a member of the Scientific Advisory Committee of the International Stroke Recovery and Rehabilitation Alliance (ISRRA). She is past editor of the journal “Motor Control”.

Early Career Investigator Award

Winner – **Naomi Gefen**

Dr. Naomi Gefen, is the Deputy Director General of ALYN Hospital Pediatric and Adolescent Rehabilitation Center in Jerusalem. She is responsible for the allied health clinical services including occupational and physical therapy, speech and language pathology, psychology, social work and education. Dr. Gefen is an occupational therapist with 30 years of experience specializing in assistive technology, medical devices, powered mobility and tele-rehabilitation for children with disabilities. She holds bachelor’s and master’s degrees in occupational therapy from the Hebrew University in Jerusalem, a master’s degree in public administration from the Harvard Kennedy School as a 2008 Wexner Israel Fellow and a PhD from the University of Haifa. She is currently pursuing a Post Doctorate in McGill University (remotely). During her 27 years in ALYN, Dr. Gefen has been involved in the development of new services (e.g., Tele Rehabilitation, National Website of Assistive Technology, Safe Transportation for Children with Disabilities and the ALYN Powered Mobility Lending Program). Dr. Gefen leads the Ministry of Health’s – Digital Health work group of Telehealth for allied health professionals.

She is a principal investigator in the ALYN Pediatric and Adolescent Rehabilitation Research (PARC) Center where she heads the domain of novel technologies for children with motor and cognitive impairments.

Runner Up – Sebastian Rutkowski

Sebastian Rutkowski is a physiotherapist, researcher, and assistant professor with expertise in the fields of rehabilitation and physical therapy. Sebastian completed his Bachelor's and Master's studies in Physiotherapy at the Opole University of Technology, where he later joined as an Assistant Professor. He continued his academic journey by pursuing a PhD in physical culture sciences from the Academy of Physical Education in Wrocław, specializing in the field of physiotherapy. Currently, he is also pursuing further studies in osteopathy at the Academy of Osteopathy.

With a passion for research and innovation, Sebastian has been actively involved in various research projects throughout his career. His research focuses on the application of virtual reality in rehabilitation, especially for patients with chronic obstructive pulmonary disease (COPD) and post-COVID-19 patients. His work has been published in esteemed scientific journals, including Frontiers in Public Health, European Respiratory Journal, among others. Sebastian has authored over 50 publications, including systematic reviews, meta-analyses, and original research articles. Sebastian's professional experience spans across different healthcare settings. He has worked as a physiotherapist in his own clinic in Opole, Poland, since 2016, providing specialized care and treatment to his patients. Additionally, he has gained valuable international experience through research positions at the National Research Council of Italy in Lecco and San Camillo IRCCS S.R.L. in Venezia.

Recognized for his expertise and dedication, Sebastian has been actively involved in professional associations and societies. He serves as the Vice-Chairman of the Association for Oncological Assistance and Rehabilitation in Poland, demonstrating his commitment to improving the lives of cancer patients through comprehensive rehabilitation.

Conference Awards

Best Poster & Podium Talk Awards

The ISVR Best Poster and Podium Talk Awards are awarded to the most innovative and exciting conference contributions as identified by a panel of junior and senior ISVR members led by the Awards Co-Chairs. Each award is given to a junior (student, postdoc) and a senior (3 years from terminal degree) recipient. Recognition includes a cash prize (for junior awardees only), recognition on the website and in an ISVR Newsletter/eblast, and a certificate.

Best Product Demonstration Award

The ISVR Best Product Demonstration Award will be presented to the demo that best represents innovative and exciting clinical applications of virtual reality for assessment or intervention purposes. Recognition includes a cash prize, placement on the website and in an ISVR Newsletter/eblast, and a certificate. Award decision is determined by a panel of junior and senior ISVR members led by the Awards Co-Chairs.

Keynote Speaker Bio's

Jennifer Campos, *Toronto Rehabilitation Institute*

Dr. Jennifer Campos is a Canada Research Chair (II) in Multisensory Integration and Aging. She is a Senior Scientist, Chief Scientist of the Challenging Environments Assessment Laboratory, and the Associate Director–Academics at KITE, Toronto Rehab–UHN. Jenny is also the Associate Scientific Director of AGE-WELL and an Associate Professor of Psychology (University of Toronto). Jenny's research focuses on multisensory self-motion perception and mobility (e.g., walking, driving) under realistic and challenging conditions. This includes understanding how age-related sensory loss (e.g., vision, hearing) and cognitive declines can increase the risk of falls and vehicle collisions. She uses VR and simulation technologies to a) systematically manipulate aspects of multisensory experiences (sights, sounds, motions) to examine how sensory inputs are integrated in the brain; b) optimize simulation technologies for use as novel tools for research and application and c) help bridge the gap between highly-controlled lab studies and real-world impact.

Elaine Biddiss, *Bloorview Research Institute*

Dr. Elaine Biddiss is a senior scientist with the Bloorview Research Institute at Holland Bloorview Kids Rehabilitation Hospital, Associate Professor with the Institute of Biomedical Engineering and Member of the Rehabilitation Sciences Institute at the University of Toronto. She holds the Bloorview Childrens Hospital Chair in Pediatric Rehabilitation. With her team, Elaine is dedicated to creating and evaluating innovative games and apps that support young people of all abilities to achieve their goals in both recreation and rehabilitation. She embraces an interdisciplinary design approach and enjoys the challenges of integrating engineering, medicine, arts, and design. In 2021, Elaine co-founded Pearl Interactives, a start-up dedicated to translating her team's research innovations into the hands of kids, their families, and clinicians.

General Meeting Information

Venue Wi-Fi Access

Network Name: **Delta Conference**
Password: **Delta123**

Registration

Conference registration fees include: access to entire conference program (keynote speakers, awards sessions, symposia sessions, individual orals, the debate and dedicated poster sessions), professional development opportunities, welcome reception, daily coffee breaks, complimentary Wi-Fi in the congress space, digital program, and the opportunity to network with colleagues, collaborators and others in the Virtual Rehabilitation community.

Name Badges

Your name badge is your admission ticket to all conference sessions, coffee breaks, and the opening reception. **Please wear it at all times.** At the end of the conference, we ask that you recycle your name badge in one of the name badge recycling stations that will be set out or leave it at the registration desk.

Lost Name badges

There is a $25 replacement fee for any lost or missing name badges – If you've lost your name badge, visit the registration desk for a replacement as soon as possible.

Registration and Information Desk Hours

The WCISVR registration and information desk, located in the Opus 2 Foyer (Interlude) will be open during the following dates and times:

Sunday, July 23	08:00 – 18:00
Monday, July 24	08:00 – 17:30
Tuesday, July 25	08:00 – 18:00

If you need assistance during the conference, please visit the registration desk.

Poster Information

POSTER SESSION 1:
Monday, July 24, 2023

Set Up:
Between **17:00 – 19:00** on Sunday July 23, 2023 or before **09:45** on July 24, 2023

Session Time: 10:15 – 11:15

Tear Down: Please tear down by 16:00

POSTER SESSION 2:
Tuesday, July 25, 2023

Set Up:
Between **16:00 – 19:00** on Monday July 24, 2023 or before **09:00** on July 25, 2023

Session Time: 09:45 – 10:45

Tear Down: Please tear down by 13:00

Any posters that are not taken down by the removal deadline will be held at the registration desk until the end of the conference. Any posters that remain unclaimed by the end of the conference will be disposed of. Information on Poster Authors (Primary), Poster Numbers and Poster Titles begins on page 23.

Staff

ISVR staff from Podium Conference Specialists can be identified by bright orange **STAFF** ribbons on their name badges. Feel free to ask anyone of our staff for assistance. For immediate assistance please visit us at the registration desk.

Meals

There will be daily coffee breaks and an opening reception included in your conference registration fees. Students who sign up in advance for the Mentoring Lunch will also receive a lunch.

Dietary Requirements

All food & beverage served at breaks and the opening reception will be marked clearly. We have made every effort to select a variety of items to ensure inclusivity in what is provided.

Special Conference Events

OPENING RECEPTION

Sunday, July 23, 2023, from 17:30-18:30

All delegates are welcome! Please join us for light refreshments, drinks, and networking as we gather in person for the first time since 2019.

STUDENT MENTORING LUNCH

Monday, July 24, 2023, from 12:45-14:15

Students and postdocs – take advantage of this opportunity to ask questions of and receive advice from leading experts in the field of virtual rehabilitation. This informal lunch gives you access to a diverse array of researchers, each of whom has something to offer you in terms of advice, insight, or connections. Don't miss it!

DEBATE: *IS VIRTUAL REHABILITATION WITH ECOLOGICAL VALIDITY A WASTE OF TIME?*

Monday, July 24, 2023, at 14:15-15:15

The hour-long debate session has long been a highlight of our conference series! Impassioned experts collegially defend opposing sides of a contentious issue in the field of virtual rehabilitation, promising an entertaining and eye-opening experience. Whether you believe that virtual environments should be as similar as possible to the real world, or whether researchers, clinicians and developers should harness the potential of virtual reality to simulate engaging, other-worldly tasks and environments, you will leave this debate session enlightened and entertained!

CONFERENCE DINNER

Tuesday, July 25, 2023, at 18:45 – $85/person

**Tickets are still available and can be purchased at the registration desk. Must be purchased before Tuesday, noon.*

Please join us for a celebratory dinner with your colleagues and new friends.

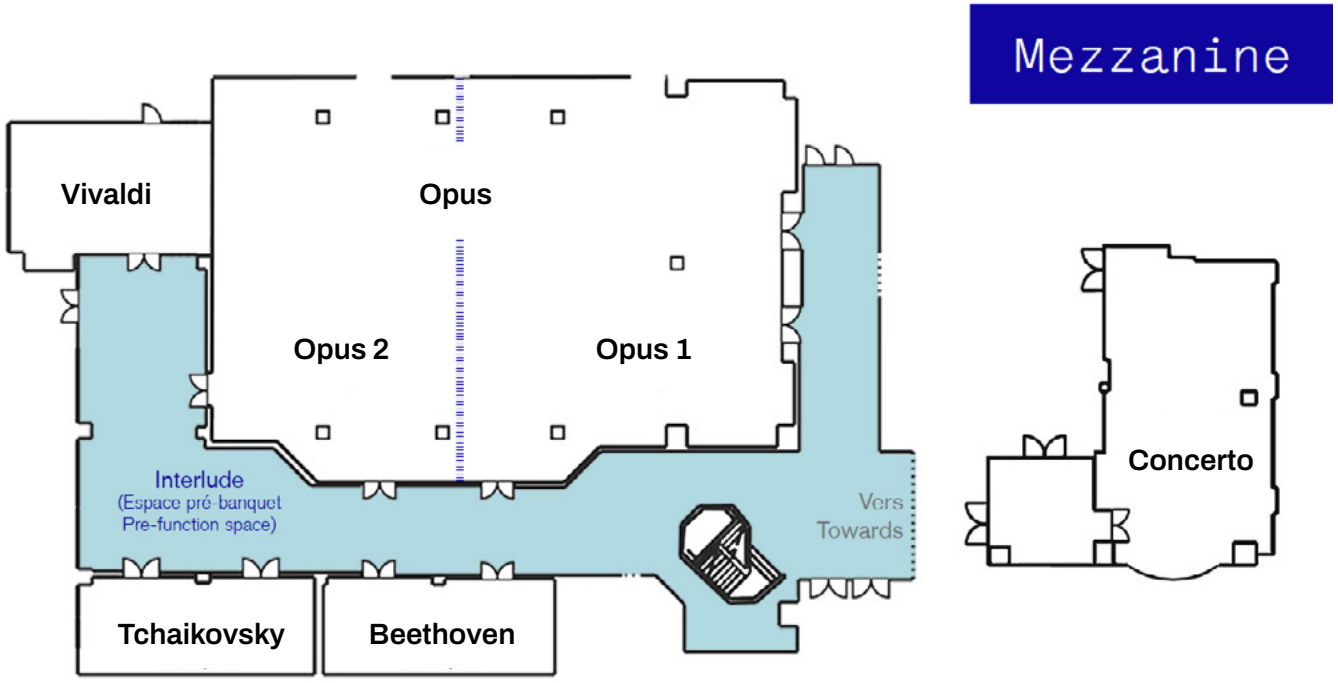
POST CONFERENCE LAB TOUR

Wednesday, July 26, 2023, at 10:00 – $40/person

**Tickets are still available and can be purchased at the registration desk. Must be purchased before Tuesday, noon.*

We are very excited to announce a new post-conference activity to tour the Jewish Rehabilitation Hospital-CISSS Laval Research Site of CRIR. We will be able to tour the labs listed below to learn more about their research. The tour will take place on the morning of July 26th with a departure from the Delta Montreal at 10am. The tour will be three (3) hours long and will include light refreshments and will cost $40/ per person USD.

Venue floor plan



Program Schedule

SUNDAY, JULY 23 2023

08:30 – 12:00 Vivaldi

WORKSHOP 1

Design, Development and Evaluation of Virtual Rehabilitation Applications Via Participatory Design With Non-Profit and For-Profit Stakeholders

Speakers:

Naomi Gefen, *ALYN Hospital*
Philippe Archambault, *McGill University*
Patrice (Tamar) Weiss, *ALYN Hospital, University of Haifa*
Laurent Gosselin, *Gravity Rehabilitation*
Karl-Emanuel Dionne, *Gravity Rehabilitation*
Lisa Blake, *Augment Therapy*
Jean-Francois Malouin, *Super Splendide*

08:30 – 12:00 Opus

WORKSHOP 2

Virtual Reality Technology for the Clinician

Speaker:

Grigore C. Burdea, *Rutgers University*

10:00 – 10:30 Interlude Foyer

COFFEE BREAK

12:00 – 14:00

FREE TIME

14:00 – 14:30 Opus

WELCOME

Speaker:

Philippe Archambault, *McGill University*

SUNDAY, JULY 23 2023

14:30 – 15:30 Opus

KEYNOTE 1

Moderated by:
Gerard Fluet, *Rutgers University*

Using Virtual Reality to Examine Multisensory and Cognitive Interactions Supporting Mobility in Older Adults

Abstract: As we move through the world, our brain has the extraordinary task of seamlessly integrating information from across our various sensory systems including, vision, audition, proprioceptive and vestibular inputs. By optimally integrating these sensory inputs, this allows us to estimate self-movement parameters such as speed, distance, and heading direction with greater precision than any one sensory input alone. My research program is aimed at quantifying how these multiple sensory inputs are integrated in the brain and how this supports behaviours such as walking and driving. Our research exploits the unique benefits of basic perceptual tasks and employs simulation and Virtual Reality (VR) technologies to develop models of multisensory self-motion perception and understand sensory-cognitive interactions during basic and more realistic behaviours.

In this talk I will present my research on understanding how multiple sensory inputs are integrated in the brain during self-motion, how multisensory integration changes with older age, and how age-related sensory and cognitive declines are associated with changes to balance and driving performance.

Speaker:
Jennifer Campos, *Toronto Rehabilitation Institute*

15:30 – 16:00 Interlude Foyer

COFFEE BREAK

16:00 – 17:30 Opus

ORAL SESSION 1

Moderated by:
Mindy Levin, *McGill University &* **Marika Demers,** *Université de Montréal*

Upper limb virtual rehabilitation

Speakers:

Qinyin Qiu, *Rutgers University*

Alaina Tulskie, *Delsys*

Audrey Ferron, *Centre de recherche du CHU Sainte-Justine*

Jigna Patel, *Rutgers University*

Sandeep Subramanian, *University of Texas, San Antonio*

SUNDAY, JULY 23 2023

17:30 – 18:30 Concerto

OPENING RECEPTION

Please join us for light refreshments, drinks, and networking as we gather in person for the first time since 2019.

MONDAY, JULY 24 2023

08:30 – 09:30 Opus

KEYNOTE 2

Moderated by:
Danielle Levac, *University of Montreal*

Bridging Opportunity Gaps in Pediatric Rehabilitation, Play and Learning Through Low-Cost Virtual Technologies

This talk will explore the design and implementation of low-cost technologies to create possibilities for: (1) family-centred rehabilitation interventions, (2) reimagining clinical assessment, and (3) promoting participation for children with disabilities. With a focus on therapeutic gaming and low-cost sensors for capturing human movement, Dr. Biddiss hopes to bridge opportunity gaps for families who are unable to access care or participate in research via traditional pathways. Central to this work is the voice of knowledge holders, particularly children, and bringing the spirit of playfulness to rehabilitation.

Speaker:
Elaine Biddiss, *Bloorview Research Institute*

09:30 – 09:45 Opus

EARLY CAREER AWARD WINNER TALK

Moderated by:
Patrice (Tamar) Weiss, *ALYN Hospital, University of Haifa*

How Early Can Early Be? The Dilemma of a Senior Clinician But Early Career Scientist

Abstract: This presentation will focus on the importance of clinical experience when starting (and continuing) to do research. I will present the different areas of impact that my 30-year clinical journey has had on my research with a focus on knowledge translation, policy and clinical intervention.

Speaker:
Naomi Gefen, *ALYN Hospital*

MONDAY, JULY 24 2023

09:45 – 10:00 Opus

EARLY CAREER AWARD RUNNER UP TALK

Moderated by:
Sandeep Subramanian, *University of Texas, San Antonio*

Virtual Reality for Pulmonary Rehabilitation: Solution or White Elephant?

Abstract: This presentation aims to showcase the awardee's research endeavors in the integration of virtual reality (VR) technology into pulmonary rehabilitation. The discussion will encompass an overview of existing pulmonary rehabilitation programs, followed by an exploration of the potential substitution of traditional components with VR-based training. Research projects undertaken by the awardee will be presented, along with their corresponding findings. Furthermore, the presentation will elucidate future research directions aimed at benefiting patients afflicted by chronic lung diseases and individuals experiencing post-acute sequelae of COVID-19.

Speaker:
Sebastian Rutkowski, *Opole University of Technology*

10:00 – 10:15 Opus

FAST FORWARD 1

Moderated by:
W. Geoffrey Wright, *Temple University*

10:15 – 11:15 Interlude Foyer

POSTER SESSION 1 & COFFEE BREAK

11:15 – 12:45 Opus

ORAL SESSION 2

Moderated by:
Gerard Fluet, *Rutgers University &* **Maxime Robert***, Université Laval*

Personalization of Virtual Rehabilitation

Speakers:
Salvatore Luca Cucinella, *Delft University of Technology*
Minxin Cheng, *Northeastern University*
Daniela Chan Viquez, *University of Toronto*
Samory Houzangbe, *Centre de recherche du CHU Ste-Justine*

12:45 – 14:15 Aroma Restaurant

LUNCH ON OWN & STUDENT MENTORING LUNCH

Moderated by:
Marika Demers, *University of Montreal*

MONDAY, JULY 24 2023

14:15 – 15:15 Opus

DEBATE

Moderated by:
Anouk Lamontagne, *McGill University*

Is Virtual Rehabilitation With Ecological Validity a Waste of Time?

Speakers:
YES Team:
Gerard Fluet, *Rutgers University &* **W. Geoffrey Wright**, *Temple University*

NO Team:
Tatiana Ogourtsova, *McGill University &* **Naomi Gefen**, *ALYN Hospital*

15:15 – 16:00 Opus

ICDVRAT ORAL SESSION

Moderated by:
Sandeep Subramanian, *University of Texas, San Antonio &*
Rigina Skeva, *The University of Manchester*

Speakers:

Gordon Tao, *The University of British Columbia*

Iveta Fajnerová, *National Institute of Mental Health*

Bernie Garrett, *The University of British Columbia*

16:00 – 16:30 Interlude Foyer

COFFEE BREAK

16:30 – 17:45 Opus

ORAL SESSION 3

Moderated by:
Judy Deutsch, *Rutgers University &* **Joyce Fung**, *McGill University*

Locomotion in Virtual Environments

Speakers:
Eva Kehayia, *McGill University*

Alex Van Den Berg, *Delft University of Technology*

Thiago De Aquino Costa Sousa, *McGill University*

Elizabeth Wilson, *Temple University*

TUESDAY, JULY 25 2023

08:30 – 09:30 Opus

DISTINGUISHED SERVICE AWARD TALK

Moderated by:
Patrice (Tamar) Weiss, *University of Haifa*

Front Seat on Mouse's Wild Ride - 25 Years

Abstract: The talk will review the development of virtual reality (VR) applications for sensorimotor rehabilitation throughout my career, starting with the acquisition of one of the first 3D programmable VR applications in the early 2000s. Research describing the validity and effectiveness of 2D and 3D VR systems will be presented, with a particular emphasis on how movements made in different VR environments may be similar or different from those made in physical environments

Speaker:
Mindy Levin, *McGill University*

09:30 – 09:45 Opus

FAST FORWARD 2

Moderated by:
Philippe Archambault, *McGill University*

09:45 – 10:45 Interlude Foyer

POSTER SESSION 2 & COFFEE BREAK

10:45 – 12:15 Opus

ORAL SESSION 4

Moderated by:
Patrice (Tamar) Weiss, *University of Haifa &*
Tatiana Ogourtsova, *McGill University*

Telerehabilitation

Speakers:
Gerard Fluet, *Rutgers University*
Dalya Al-Mfarej, *Delsys*
Isabelle Roy, *University of Montreal*
Tal Krasovsky, *University of Haifa*

12:15 – 13:45

LUNCH ON OWN

13:45 – 15:15 Opus

ORAL SESSION 5

Moderated by:
Bradford McFadyen, *Laval University &* **Tal Krasovsky**, *University of Haifa*

Sensory Function and Balance

Speakers:
William Wright, *Temple University*
Alessia Vitullo, *McGill University*
Katrin Schulleri, *Technical University of Munich*
Alexandra Canori, *Temple University*

TUESDAY, JULY 25 2023

15:15 – 16:15 Interlude Foyer

PRODUCT DEMONSTRATION & COFFEE BREAK

Pressenters:

Eric Dumais, *IRegained Inc.*

Demonstration of the IRegained Inc. MyHand System

Frederic Lachmann, *NeuroFlex*

NeuroFlex Product Demonstration v2

Iveta Fajnerová, *National Institute of Mental Health*

OCD House – Virtual Reality Exposure Therapy for Obsessive-Compulsive Disorder

Qinyin Qiu, *Rutgers University*

R3THA: Rehabilitation Technologies for Hand and Arm

Karine Latulippe, *Université TÉLUQ*

A Virtual Reality Motorized Mobility Scooter Simulator to Improve Travel Safety

Joyce Fung, *McGill University*

A computerized tool in vestibular rehabilitation to assess eye movements and the perception of visual vertigo

Katrin H. Schulleri, *Technical University of Munich*

Demonstration of a Haptic Vest in the Use Case of Improving Balance Control

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16:15 – 17:45 Opus

ORAL SESSION 6

Moderated by:

W. Geoffrey Wright, *Temple University &* **Iveta Fajnerova,** *National Institute of Mental Health*

Aging and Cognition

Speakers:

Judith Deutsch, *Rutgers University*
Grigore Burdea, *Bright Cloud International Corp*
Jacob Van Dehy, *Leidos*
Omer Dilian, *University of Haifa*
Francesca Morganti, *University of Bergamo*

TUESDAY, JULY 25 2023

17:45 – 18:15 Opus

CLOSING REMARKS & AGM

Join us for the announcement of out Best Talk, Best Platform and Best Product Demonstration Awards, an update on the society as it is now, and where we are going in the future. Further, we will announce the location of our 2024 WCISVR Conference!

Speaker:
Philippe Archambault, *McGill University*

18:45 – 21:00

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Université de Montréal

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CRIR

CRIR
Centre de recherche interdisciplinaire en réadaptation du Montréal métropolitain

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Poster Sessions

POSTER SESSION 1
Monday, July 24 10:15 - 11:15

POSTER SESSION 2
Tuesday, July 25 9:45 - 10:45

The poster board numbers work in the following way: Session – Board Number (e.g. P1-1)

Poster Session 1

Monday, July 24 10:15 - 11:15

P1-1 *The Acceptability of Mobile Virtual Reality Therapy for Alcohol Misuse Treatment in Adult Drinkers*

Rigina Skeva, *The University of Manchester*
Steve Pettifer, *The University of Manchester*
Caroline Jay, *The University of Manchester*
Lynsey Gregg, *The University of Manchester*

Alcohol misuse is a global health issue, often associated with relapse episodes during and after treatment. Easy access to treatment could prevent relapse when high-risk situations are encountered. However, this is not always possible, for example amidst pandemics, or when patients live in rural areas or require out-of-hours support. Virtual Reality Therapy delivered via a mobile device (mVRT) online or in-person, could be a flexible, cost-effective solution, but whether it would be acceptable in patients has not been explored. We therefore conducted an online survey with 259 adult drinkers to determine mVRT's treatment acceptability for alcohol misuse, relatively to VRT (delivered via a standard headset) and typical alcohol treatments available in healthcare systems. Predictors of acceptability regarding familiarity with and preference for mVRT, VR experience, treatment delivery preferences, hazardous drinking, perceived stigma, treatment uptake attitudes, gender, ethnicity and mental health were also considered. MVRT was perceived less acceptable than VRT and traditional treatments. Treatment familiarity and preference for mVRT, VR experience, stigma, treatment uptake attitudes, mental health and gender were related to mVRT's acceptability. Familiarisation procedures in delivery protocols could increase mVRT's acceptability, especially in patients who experience alcohol stigma, co-occurring mental health issues or do not use technology regularly.

P1-2 *Using Interactive Computer Play in Clinical Practice in Pediatric Rehabilitation*

Marina Petrevska, *Holland Bloorview Kids Rehabilitation Hospital; University of Toronto*
Jennifer L. Ryan, *Holland Bloorview Kids Rehabilitation Hospital*
Selvi Sert, *Holland Bloorview Kids Rehabilitation Hospital*
Virginia Wright, *Bloorview Research Institute*
Elaine Biddiss, *Holland Bloorview Kids Rehabilitation Hospital*

This observational study documented the motor learning strategies (MLS) that are integrated into Bootle Blast, an interactive computer play system, and those which are added or enhanced by clinician involvement. Video-recorded therapy sessions using Bootle Blast were reviewed by two raters and scored using a validated MLS rating scale. Eight MLS were effectively delivered via visual/audio prompts within Bootle Blast including: directing attention to objects and relating to results. Clinician involvement led to meaningful increases in three MLS: asking to problem solve, physical guidance and practice being progressive. Further refinements to MLS elements may help to optimize the therapeutic potential of Bootle Blast.

P1-3 *Practical considerations for head-mounted display use in pediatric rehabilitation: a narrative review*

William Fortin, *Université du Québec à Montréal*

Camille Bisaillon, *University of Montreal*

Danielle Levac, *University of Montreal, CHU Sainte Justine*

Non-immersive (flat-screen display) virtual reality (VR) has become an accepted pediatric rehabilitation tool, but immersive VR (head-mounted displays [HMDs]) are in the early stages of adoption and evaluation in this field. Little information exists to inform clinical decision-making about HMD use in rehabilitation. We undertook a narrative review to 1) Categorize available HMDs; 2) Identify manufacturer guidelines specific to pediatric use; and 3) Synthetize contextual information regarding HMD use in pediatric rehabilitation. Of twenty-four HMDs (19 manufacturers) with an English online presence, 9 included small amounts of pediatric-specific information in their guidelines. Fourteen studies involving pediatric cognitive or physical rehabilitation populations published between 2018-2023 took place in hospital or laboratory settings. HMD use was an average of 1.8 sessions/participant for an average duration of 15.4 (SD 10.1) minutes. The most reported side effect was nausea, followed by dizziness, headache, and eye strain. More research is required to address gaps in evidence for more frequent, longer-term use in different populations and settings. With larger sample sizes, studies should explore the impact of individual (i.e., age, diagnostic) and contextual (i.e., type of HMD, interaction method) factors. Review findings will inform initial pediatric rehabilitation use recommendations that will evolve as new evidence emerges.

P1-4 *AVA: AI-driven Virtual Rehabilitation Assistant*

Ali Abedi, *KITE-Toronto Rehabilitation Institute – University Health Network*

Tracey J.F. Colella, *KITE-Toronto Rehabilitation Institute – University Health Network*

Mark Bayley, *KITE-Toronto Rehabilitation Institute – University Health Network*

Urvashy Gopaul, *KITE-Toronto Rehabilitation Institute – University Health Network*

Abhinav Mahajan, *International Institute of Information Technology Bangalore*

Tarun Reddy, *International Institute of Information Technology Bangalore*

Fateme Pourghasem, *University of Toronto*

Dinesh Babu Jayagopi, *International Institute of Information Technology Bangalore*

Shehroz S. Khan, *KITE-Toronto Rehabilitation Institute – University Health Network & University of Toronto*

Virtual rehabilitation has gained popularity in delivering personalized programs of exercise, education, and counseling to the home of patients. Despite the potential benefits of virtual rehabilitation programs in reducing rehospitalization and death, high dropout rates pose a significant obstacle to their effectiveness. This is due to several barriers, including a lack of motivation and confidence in completing rehabilitation exercises. This paper introduces an AI-driven Virtual Assistant (AVA) to assist patients in completing their prescribed rehabilitation exercises at home. AVA uses AI algorithms to analyze patients' movements and provide them with real-time personalized feedback. The web application containing AVA can be accessed from any camera-enabled computer or mobile device without the need for additional hardware. Through a co-design approach, the movement training components of AVA for upper-limb stroke rehabilitation exercises were developed and reviewed by the research team, including a patient partner. The importance of including an avatar in virtual rehabilitation and providing real-time feedback to guide patients in performing exercises correctly was emphasized by the patient partner. AVA has the potential to enhance healthcare outreach, increase program participation and completion, and improve long-term health outcomes.

P1-5 *Feasibility of computerized and immersive VR-based visuomotor integration assessment in a busy cerebral palsy clinical setting*

Minxin Cheng, *Northeastern University*
Alexa Craig, *Barbara Bush Children's Hospital, Maine Medical Center*
Danielle Levac, *University of Montreal*

Visuomotor integration (VMI) difficulties can impact activities of daily living in children with cerebral palsy (CP). Compared to paper-and-pencil assessments, both computerized, eye- and hand-tracking enabled, reach-to-touch interactions and immersive virtual reality (VR; viewed in a head-mounted display [HMD]) tasks may provide more ecologically valid VMI assessment methods. This study evaluated the implementation feasibility of a computerized reach-to-target touchscreen task and an immersive VR VMI assessment in 12 children with unilateral or bilateral CP in a busy clinic environment. Equipment was transported to the clinic by the researchers and set up in a small (6ft x 6ft) clinic room. In the computerized condition, data loss secondary to suboptimal screen-based eye tracker interactions limited implementation feasibility. In immersive VR, implementation was restricted by children's difficulty interacting with the virtual targets, as quantified by a high frequency of unsuccessful virtual object interaction attempts. Findings from this small, heterogeneous sample indicate that our method of computerized and immersive VR VMI assessment is not feasible outside of the laboratory. Results can inform subsequent studies exploring the use of technological-based assessments in typical clinic environments.

P1-6 *Body Coordination during Walking and Turning on an Omnidirectional Treadmill with Virtual Reality: Research Protocol*

Thiago Vidal Pereira, *McGill University*
Andréanne K. Blanchette, *Université Laval, Cirris*
Philippe Archambault, *McGill University*
Anouk Lamontagne, *McGill University*

This study aims to investigate the impact of a self-paced omnidirectional treadmill with virtual reality on movement coordination and gait temporal-distance factors. Twenty healthy young adults (aged 18 to 29 years) will be assessed while walking and turning on an omnidirectional treadmill with and without virtual reality (VR) vs. overground without VR. Full-body kinematics and temporal distance factors will be recorded using the Xsens motion tracking system. Amplitudes and onset times of axial body segment reorientation in the horizontal plane and heading, as well as step length, cadence and step width will be compared across conditions. Results will provide insights into the impact of VR-based omnidirectional treadmill set-up on steering strategies, informing an eventual use in rehabilitation.
Keywords — Locomotion, Movement Coordination, Omnidirectional Treadmill, Steering, Virtual Reality

P1-7 *Establishing Normative Ranges for Students Using NeuroFlex® - a Virtual Reality Based Software*

Frederic Lachmann, *NeuroFlex*
Arianna Soave, *NeuroFlex*
Antoine Tantin, *NeuroFlex*
Mimi Galiana, *NeuroFlex*

This paper discusses the use of NeuroFlex® software, which is a Virtual Reality (VR) approach used to assess oculomotor function and record data from both head and eye responses. This provides valuable brain health-related metrics during the baseline assessment process that can then be used during assessment following a head injury in various settings. A total of 378 male students, ages 10-18 were baselined using NeuroFlex®, and normative ranges for each of the 61 NeuroFlex® metrics were calculated and established. This VR-based tool is essential in assessing overall brain health, and calculating age-specific normative ranges is important for identifying individual weaknesses and developmental issues. Recognizing and identifying outliers (especially those with lower performance) is key to supporting the development and brain health of individuals within a group. The software is useful in detecting outliers within a cohort that can then be used to establish tailored rehabilitation plans after

head injuries as to optimize outcomes. This document demonstrates the usefulness of NeuroFlex® in establishing age-specific normative ranges that can be used to assess oculomotor function and ensuring the safe participation of youth in sports and in school settings.

P1-8 *Split-belt treadmill training to rehabilitate freezing of gait and balance in Parkinson's Disease*

Sanskriti Sasikumar, *Toronto Western Hospital*
Gianluca Sorrento, *health network*
Alfonso Fasano, *University of Toronto*

Split-belt treadmill (SB-TM) training has been proposed to improve gait symmetry and overall gait performance of patients with Parkinson's disease (PD). To assess the rehabilitation potential of this intervention, we have designed a prospective, double-blind, parallel-group randomized control trial with 3-month follow up to test the efficacy of SB-TM training compared to conventional treadmill training to improve gait parameters and reduce falls in PD.

P1-9 *A study on satisfaction of VR-based social reintegration program experience for persons with disabilities*

Jung Ah Lee, *Korea National Rehabilitation Center*
Aerim Kim, *Korea National Rehabilitation Center*
Hye Min Choi, *Korea National Rehabilitation Center*
Sung Shin Kim, *Korea National Rehabilitation Center*
Hyosun Kweon, *Korea National Rehabilitation Center*

This study investigated the satisfaction of individuals with disabilities (PWDs) participating in VR-based social reintegration programs for rehabilitation. The study included 29 participants, primarily stroke survivors (26 participants), along with one traumatic brain injury and two cerebral palsy cases. The VR program offered three types of experiences: floor-type VR, wall-type VR, and immersive VR using a head-mounted display, allowing participants to virtually engage in daily activities such as fishing, cooking, farming, and sports. The satisfaction survey questionnaire assessed participants' experiences across five components: environment, instructor, program time, overall satisfaction, and re-participation intention, using a 5-point Likert scale. The average satisfaction scores were 4.8, 4.9, 4.7, 4.8, and 4.7 for environment, instructors, time, satisfaction, and re-participation intention, respectively. These promising results can guide future VR content development, as the technology shows potential for motivation and rehabilitation effects in PWDs.

P1-10 *User-centered Development and Validation of Virtual Reality Tasks to Enhance Driving Skills of Older Adults Using Motorized Mobility Scooters.*

Karine Latulippe, *Université TÉLUQ*
Claudine Auger, *University of Montreal*
François Routhier, *Université Laval*
Ben Mortenson, *University of British Columbia*
Manon Guay, *Université de Sherbrooke*
William C Miller, *University of British Columbia*
Dahlia Kairy, *University of Montreal*
Philippe Archambault, *McGill University*

Approximately 108,00 Canadians employ a motorized mobility scooter (MMS) for their mobility needs. MMS facilitate community participation and an independent lifestyle. Training is needed for users to benefit from a MMS, while avoiding accidents and injuries. However, very few MMS users receive formal training. One potential method to teach these strategies is through a virtual reality (VR) simulator. Our team has previous experience in the development and validation of low-cost simulators for manual and power wheelchairs, which we now wish to apply to MMS tasks. Objective 1: evaluating the experience of participants involved in the user-centered development of VR tasks. A team consisting of a MMS user, an occupational therapist, a VR specialist and researchers co-developed a first VR task for MMS training, through an iterative process. Experience with respect to roles, expectations and outcomes were gathered from individual interviews. Objective 2: validation of the developed VR tasks. MMS users and clinicians tested the task and were then interviewed about their experience on the system's usability. This

study will allow the development and improvement of VR tasks based on the needs of MMS users. We hope to then elaborate a new MMS training program, combining both VR and real tasks.

P1-11 *Age effects on Performance and brain Engagement during simulation of an internet-based shopping task*

Rachel Kizony, *University of Haifa*
Marva Talmi, *University of Haifa*
Tal Krasovsky, *University of Haifa*

The aim of the present study was to compare young and older adults' performance (behavioral and brain engagement) of a simulation of an internet-based shopping task in two levels of difficulty. The older adults' performance was significantly worse on behavioral outcomes only (e.g., accuracy) pointing to possible deficits in executive functions required to perform this functional activity.

P1-12 *LogVS: Developing an affordable and user-friendly virtual reality platform to study, assess and train different aspects of locomotor navigation*

Joris Boulo, *Université Laval*
Andréanne K. Blanchette, *Université Laval, Cirris*
Alexandra Cyr, *Université Laval*
Jonathan Caron-Roberge, *Université Laval*
Philip Jackson, *Université Laval*
Charles S. Batcho, *Université Laval*
Anouk Lamontagne, *McGill University*
Bradford McFadyen, *Université Laval, Cirris*

Virtual reality (VR) shows promise for research in the area of locomotor navigation. However, VR platforms often lack a social environmental context involving pedestrian interactions and goal-oriented locomotor adaptations over ground. The present work describes the early development of an affordable, mobile VR platform involving over ground walking within a park with pedestrians, to study, assess and train different aspects of locomotor navigation. Focus groups with clinicians assessed the perceived clinical needs regarding the assessment and treatment of locomotor navigational skills and acceptability of such a platform. This revealed that there is a significant clinical need for standardized tools for locomotor navigation for neurological rehabilitation. However, clinicians pointed that the platform could benefit from added complexity to the scenarios. Finally, the criterion validity and test-retest reliability of the data on position and orientation extracted from the standalone head mounted display provide a promising direction for future research and development of a VR platform for locomotor navigation in social environmental contexts.

Poster Session 2

Tuesday, July 25 9:45 - 10:15

P2-1 *Novel Evaluation Tool for Visuospatial Neglect by using eye tracker-implemented head mount display*

Yuya Ohashi, *Shibaura Institue of Technology*
Yusaku Takamura, *National Rehabilitation Center for Persons with Disabilities*
Shin-Ichiro Yamamoto, *Shibaura Institute of Technology*
Noritaka Kawashima, *Research Institute, National Rehabilitation Center for Persons with Disabilities*

The aim of this study is to develop a novel evaluation tool for strategy of head-eye coordination based on the virtual environment by using head mount display. We prepared simple visual search task with absolute and relative coordinate. While absolute coordinate resembles to real world situation, relative coordinate enable patient to use head movement for the visual search. Similarity and difference of the eye and head motion between two conditions would give us to know whether a patient utilize head-eye coordination or not. Our developed system effectively shows unique behaviour in patients with visuospatial neglect and enables us for the dissociative evaluation of eye and head motion without head restraint.

P2-2 *Constructing a gait analysis environment with virtual reality*

Kuni Konaka, *Osaka Yukioka College of Health Science*
Kenji Kasubuchi, *Osaka Yukioka College of Health Science*
Noriaki Hattori, *University of Toyama*
Hideki Mochizuki, *Osaka University Graduate School of Medicine*

Along with the development and widespread use of virtual reality technology, a variety of physical activities are now able to be carried out with greater ease in more realistic visual environment. We focused on the gait control and investigated the effect of virtual visual information on gait. We built a gait analysis system using a head-mounted display and virtual environment and showed that modifying visual space by using virtual reality technology can influence gait control.

P2-3 *How do individuals with chronic traumatic brain injury avoid collisions with pedestrians presenting emotional gait patterns.*

Azba Shaikh, *McGill University*
Sean Lynch, *McGill University; CRIR*
Anouk Lamontagne, *McGill University*
Bradford McFadyen, *Université Laval, Cirris*
Philip Jackson, *Université Laval*

Avoiding collisions with surrounding pedestrians is necessary to navigate safely in the community. Adults with moderate-to-severe traumatic brain injury (m/sTBI) show less confidence in navigating complex environments and difficulty understanding the emotions of others. Thus, we aim to determine the modulatory role of emotional gait patterns of interferers on collision avoidance among m/sTBI individuals (n=10) and age-matched healthy controls (n=5). Participants performed a collision avoidance task to avoid virtual interferers displaying different emotional gait patterns in a virtual metro scene. Overall, the m/sTBI group adopted slower walking speeds and larger minimum distances compared to controls. A modulatory effect of emotional gait was also observed on walking speed, minimum distance maintained from interferers and onset distance of trajectory deviation, and this modulation was similar between groups. The observed changes amongst m/sTBI participants could reflect conservative collision avoidance strategies and underlying deficits in sensorimotor and cognitive functions.

P2-4 *Sit-to-stand kinematics in older adults under virtual height manipulation*

Gili Schwartz, *University of Haifa*
Rotem Katz, *University of Haifa*
Tal Krasovsky, *University of Haifa*
Michal Kafri, *University of Haifa*

Sit-to-Stand transfer is a critical component of functional independence and a targeted goal in motor training for elderly individuals with functional impairments. Manipulating ecological constraints during varied motor practice has the potential to optimize practice outcomes. Sit-to-Stand kinematics were assessed in fourteen older adults under two conditions of virtual height. Preliminary results did not show significant differences between virtual conditions, but did demonstrate specific relationships between sit-to-stand kinematics and personal characteristics such as balance self-confidence and anxiety.

P2-5 *Contrast Avoidance Model of Generalized Anxiety Disorder: Scenario Selection for Virtual Treatment*

Barbora Darmová, *Charles University*
Iveta Fajnerová, *National Institute of Mental Health*

This study explores the potential therapeutic benefits of employing the contrast avoidance model (CAM) to treat generalized anxiety disorder (GAD). Long-lasting and challenging-to-control worry is a common symptom of GAD [1]. Despite the historically recognized efficacy of cognitive-behavioral therapy (CBT) with a GAD focus, its outcomes have not been optimal, emphasizing the urgent need for more effective interventions [2]. This

research aims to create and test virtual reality (VR) exposure scenarios that could be utilized along with relaxation techniques in a randomized clinical trial to determine the effectiveness of the therapeutic strategy for treating negative contrast sensitivity. This paper describes the methodology and procedure for selecting GAD-relevant scenarios and developing their simulations in VR. The programming portion will employ the Unity Real-Time Development cross-platform solution to ensure the technology is portable and accessible to the general public. This approach will enable the technology to work with a wide range of devices, from phones to immersive professional headgear, making it accessible to a large population.

References:

[1] Stein, M. B., & Sareen, J. (2015). *Generalized anxiety disorder. New England Journal of Medicine*, 373(21), 2059-2068.

[2] Fisher, P. L. (2006). *The efficacy of psychological treatments for generalised anxiety disorder. Worry and its psychological disorders: Theory, assessment, and treatment*, 359-377.

P2-6 *VirTele use intention: satisfaction with technology and interaction between therapist and participant*

Karla Vanessa Menezes, *University of Montreal*

VirTele, a personalized remote rehabilitation program combining virtual reality exergames and telerehabilitation, was developed to provide stroke survivors an opportunity to pursue rehabilitation of their chronic upper extremity (UE) deficits at home while receiving ongoing follow-up from a clinician. The Telerehabilitation is the use of information and communication technologies to provide rehabilitation at a distance and Virtual Reality is an interface that allows the user to 'interact' with and become 'immersed' in a computer-generated environment in a naturalistic fashion. Although we strongly believe Virtele is a great tool to treat stroke survivors, in order for this technology to be effectively received, it is essential measuring participant's perception about VirTele and how those perceptions may impact usage. The objective of this study is to evaluate participants' satisfaction with VirTele and the support from clinician regarding the use of technology. A total of 8 stroke survivors were randomized and allocated to a treatment group (VirTele intervention or conventional therapy). VirTele has been demonstrated a great potential to be used at home. Participants demonstrated satisfaction with the program and perceived VirTele as usefulness and ease of use. Clinician's support also presented great results.

P2-7 *Combining virtual reality and a split-belt treadmill to induce freezing of gait in Parkinson's disease*

Gianluca Sorrento, *Toronto Western Hospital, University Health Network*

Alfonso Fasano, *University of Toronto*

Freezing of gait (FOG) is a phenomenon characterized by an involuntary interruption during walking. Though very debilitating to individuals with Parkinson's disease (PD), evidence suggests less than half of individuals with a history of FOG are observed with it in clinic. This can be due to its unpredictable nature but also to the patients' motivation and sensitivity to their environment (e.g., hospital). Creating a protocol that readily elicits discrete FOG episodes in individuals with PD, in a safe virtual environment, is an important step towards better understanding and treatment of this disabling problem. We created conditions where PD individuals who either experience FOG or not can display FOG-like behaviour on a split-belt treadmill in a virtual environment.

P2-8 *Feasibility and use of a short-term error augmentation training program in virtual reality for upper limb rehabilitation in stroke survivors*

Caroline Rajda, *McGill University*

Shelly Levy-Tzedek, *Ben-Gurion University of the Negev*

Sigal Berman, *Ben-Gurion University of the Negev*

Philippe Archambault, *McGill University*

Mindy Levin, *McGill University*

Stroke leads to long lasting deficits in upper limb (UL) sensorimotor function. Many people with UL problems after stroke experience a decreased

range of elbow extension leading to the use of compensatory movements to assist reaching. Motor learning, like implicit learning, can be harnessed to improve elbow extension. Error augmentation (EA) is a feedback modality based on implicit learning. EA has been used in people with stroke to improve endpoint performance of a reaching task but changes in movement quality have not been reported. We studied the effects of short-term training with EA vs. no-EA on increasing the range of active elbow extension during a reaching task in people with stroke. Patients with stroke practiced reaching with or without EA feedback in a virtual environment 3x in 1 week. Preliminary results show that both groups improved in joint and endpoint kinematics during reaching. The results of this study will inform the design of training interventions that use enhanced intrinsic feedback for sensorimotor recovery of the UL after stroke.

P2-9 *Engaging Patients with COPD in Pulmonary Rehabilitation Program Using Virtual Reality*

Joseph Finkelstein, *University of Utah*
Aileen Gabriel, *University of Utah*

Lack of motivation combined with low health literacy in patients with chronic obstructive pulmonary disease (COPD) has been shown to be a significant deterrent to effective participation in pulmonary rehabilitation (PR) programs. We developed a VR app driven by adult learning theories to help COPD patients better understand the benefits of pulmonary rehabilitation and empower them with personalized knowledge about the role of PR in COPD management. The objective of this mixed-design study was to assess attitudes of COPD patients toward using the VR app and its impact on PR knowledge (PRK). VR-naïve patients with a history of COPD exacerbations were asked to complete the PRK survey before and after using the VR app and then undergo semi-structured qualitative interviews to provide their feedback on using the VR app. The mean age of the patients was 74±7 years ranging between 61 and 84 years old. The qualitative analysis showed that the VR-based technology received positive feedback from patients, especially for how engaging and immersive it was. A statistically significant increase in PR knowledge ($p<0.05$) was found after using the VR app. This study offers an in-depth analysis of COPD patient perspectives on using VR-based technologies and its effect on PR knowledge.

P2-10 *Family-Centered Virtual Reality Games Room*

Tatiana Ogourtsova, *McGill University*
Anouk Lamontagne, *McGill University*

Background: Virtual reality (VR) can be used in pediatric rehabilitation to enhance traditional approaches and promote family-centeredness. Our goal is to implement and pilot-test a family-centered VR games room for children with physical disabilities and their caregivers. Methods: Using a case study mixed-method study design, we will engage five (n=5) dyads (child and parent) in parallel VR sessions using the Oculus Quest. Compatible games will be selected to target upper extremity motor functions and/or trunk control (for child) and relaxation/stress reduction (for caregiver). Measures of feasibility, acceptability, satisfaction, improvements in motor functions (child) and mental health outcomes (caregiver), and users' perspectives will be collected and analyzed using descriptive statistics and a qualitative analysis approach. Contribution: To the best of our knowledge, this is the first study to implement VR in a family-centered approach, where the needs of the child and that of the caregiver are addressed. The findings of this pilot proposal will guide future efficacy trials.

P2-11 *Comparison of immersive and semi immersive cycling on exercise intensity and user experience during a bicycling task: Persons with Parkinson Disease*

Judith Deutsch, *Rutgers University*
Rosemary Gallagher, *New York Institute of Technology*
John Palmieri, *Rutgers University*
Joanne Donoghue, *New York Institute of Technology*

This study contrasts the experience of persons with Parkinson Disease who exercised in a both a semi

and fully immersive virtual cycling environment. The objective was to determine if the mode of presentation- fully or semi immersive influenced exercise intensity, enjoyment and perception of effort. Neuromuscular intensity and perception of effort were greater in the fully immersive environment. However, the neuromuscular intensity difference was not clinically meaningful. Participant preference was equally divided between presentation. For this task semi and fully immersive environments appear comparable in stimulating exercise intensity. The user experience was comparable.

Keywords: neuromuscular intensity, cardiovascular intensity, enjoyment, perception of effort, Parkinson disease, virtual reality

P2-12 *Novel assessment tool for driving capability with head/eye tracking-implemented drive simulator*

Noritaka Kawashima, *National Rehabilitation Center for Persons with Disabilities*
Yuya Ohashi, *Shibaura Institute of Technology*
Noboru Onizuka, *Creact Corporation*
Mistunori Kabashima, *Digital Design STUDIO Ltd.*

In order to establish an environment for the behavioural evaluation during car driving, we developed a novel drive simulator that consists of head/eye tracking device and custom-made 3D CG modeling based on the drone-captured test-driving field. With the use of head tracking-based view manipulation, users can get wider field of view even though the system only has single display. The developed drive simulator has been tested for the evaluation in patients post stroke, such as visuospatial neglect, attention deficit, and hemianopia. Since head/eye tracking data and recordings of the steering and pedals give us a plenty of information for car driving, our developed system would effectively work for the detection of whether a patients have a potential to re-issue driving license or not.

Oral Sessions

Oral Session 1: Upper limb virtual rehabilitation

Sunday, July 23 16:00 - 17:30

O1.1 *EEG Based Resting State Connectivity Changes Associated with Upper Limb Recovery after Home Therapy in the Chronic Phase Post-Stroke.*

Jigna Patel, *Rutgers University*
Gerard Fluet, *Rutgers University*
Alma Merians, *Rutgers University*
Michael Glassen, *New Jersey Institute of Technology*
Qinyin Qiu, *Rutgers University*
Soha Saleh, *Rutgers University*
Amanda Cronce, *New Jersey Institute of Technology*
Sergei Adamovich, *New Jersey Institute of Technology*

This preliminary investigation evaluates resting state connectivity measured via electroencephalography (EEG) as a neural biomarker of recovery post-stroke. Seven individuals with chronic stroke were included in the study. We show an association between changes in EEG based resting state directional connectivity between ipsilesional parietal and ipsilesional premotor areas and impairment based upper limb recovery subsequent to 12 weeks of home-based virtual reality training.

O1.2 *An Augmented Reality Hand Trainer for Neurological Rehabilitation*

Alaina Tulskie, *Delsys Inc*
Alexander Kupin, *Delsys and Altec, Inc.*
Serge Roy, *Delsys Inc*
Joshua Kline, *Delsys and Altec, Inc.*
Bhawna Shiwani, *Delsys and Altec, Inc.*

One of the major forms of disability from neurologic disorders is upper limb impairment. For stroke survivors, hand dysfunction results from hemiparesis, while for other neurological disorders such as Parkinson's disease (PD), hand dysfunction is associated with loss of finger dexterity due to rigidity, slowness, and involuntary movements. Hand therapy for either condition requires considerable feedback and guidance from a therapist or use of a robotic device, which are costly and of limited access to many older persons. We are developing an augmented reality (AR) hand trainer to facilitate finger and hand function by projecting virtual targets to the hand for goal-directed exercises, while tracking hand kinematics for feedback. The AR Hand Trainer was evaluated among control participants to establish tracking accuracy on par with a reference standard. Feasibility assessment among stroke survivors and individuals with PD demonstrated that this innovation is a feasible modality for hand rehabilitation based on usability and acceptance among stakeholders.

O1.3 *Activity intensity and electrodermal activity during virtual reality as compared to traditional intensive motor learning-based therapy for children with hemiplegia*

Audrey Ferron, *CHU Ste-Justine*
Samory Houzangbe, *CHU Ste-Justine*
Maxime T. Robert, *Université Laval*
Danielle Levac, *University of Montreal*

Hand-Arm Bimanual Intensive Therapy Including Lower Extremities (HABIT-ILE) requires significant motor-engaged time of bilateral tasks. Virtual reality and active video games (VR/AVGs) may engage children in intensive practice to a greater extent than traditional activities. The purpose of this study was to compare objective indicators of activity intensity (moderate to vigorous physical activity; MVPA) and engagement/arousal (electrodermal activity; EDA) between VR/AVG and traditional gross motor activities. We hypothesized similar MVPA between VR/AVG and traditional activities, and higher EDA peaks/minute during VR/AVG activities. Six children aged 8-11 years wore an Actigraph GT9X accelerometer to measure MVPA and an Empatica E4 wristband to measure EDA during equivalent periods of VR/AVG and traditional gross motor activities on 2 non-consecutive days of a 10-day HABIT-ILE program. Across both sessions, children spent significantly more sedentary time in VR/AVG activities as compared to traditional activities. There was no difference in average MVPA or EDA peaks/minute between activities. Results suggest VR/AVG systems are applicable intensive interventions, but suggest caution with respect to how VR instructions, debugging, and system set-up time may limit activity intensity. Subsequent research with larger samples should correlate neurophysiological correlates of engagement and arousal with validated self-report measures of these constructs.

O1.4 *Changes in reach to grasp kinematics after home based Virtual Rehabilitation in chronic stroke*

Qinyin Qiu, *Rutgers University*

This study examines the upper extremity functionality improvement after a three month long home-based intervention using exergames. A custom designed Reach to Grasp (RTG) test was used to identify changes in movement patterns following the intervention. A subset of RTG measures was identified that predicted clinical outcomes.

O1.5 *Virtual Reality based interventions and self reported upper limb use levels after stroke– A systematic review and meta-analysis*

Sandeep Subramanian, *University of Texas, San Antonio*
Jessica Azzopardi, *University of Texas, San Antonio*
Lisa Reitz, *University of Texas, San Antonio*

Shreya Prasanna, *University of Texas, San Antonio*

We examined the effectiveness of virtual reality (VR) based rehabilitation interventions on levels of self-reported quality and quantity of upper limb (UL) use. We conducted a systematic review and meta-analysis. The PEDro scale helped assess study quality. Summary effect sizes helped quantify intervention effectiveness. Eighteen studies met the inclusion criteria. The quality of retrieved studies ranged from moderate to good. Moderate effect sizes were obtained at the end of the intervention. At retention assessment, effect sizes were either moderate (quality of use) or large (quantity of use). Using VR based interventions can help improve self-perceived use of the more-affected UL after stroke.

Oral Session 2: Personalization of virtual rehabilitation

Monday, July 24 11:15 - 12:45

O2.1 *Towards personalized Immersive VR neurorehabilitation: A human-centered design*

Salvatore Luca Cucinella, *Delft University of Technology*
Joost De Winter, *Delft University of Technology*
Erik Grauwmeijer, *Erasmus Medical Center*
Laura Marchal-Crespo, *Delft University of Technology*

Head-mounted displays can be used to offer personalized immersive virtual reality training for patients who suffered an Acquired Brain Injury (ABI) by tailoring the complexity of visual and auditory stimuli to the patient's cognitive capabilities. However, it is still an open question how these virtual environments should be designed. We utilized a human-centered design approach to help define the characteristics of suitable training environments for patients who suffered from a stroke. We conducted observations, interviews with eleven experts (e.g., occupational- and physical therapists), and an online questionnaire with 24 neurorehabilitation experts to examine how therapists modify the training environment in order to optimize patients' recovery in conventional neurorehabilitation. Participants reported that modulating the number of elements (e.g., objects, people) or distractions (e.g., background noise) in the training environment enables therapists to provide their patients with suitable conditions to execute functional tasks. Results from this study provide valuable insights into modulating the training environment in immersive virtual reality.

O2.2 *Impact of affective and environmental factors on children's motor skill transfer from virtual to physical environments*

Minxin Cheng, *Northeastern University*
Danielle Levac, *University of Montreal*

Motion-controlled virtual reality (VR) systems are potential motor learning interventions in pediatric rehabilitation. However, more evidence for transfer of learning from VR to the real world is needed. Using a novel postural reaching task, this study evaluated the impact of affective (i.e., motivation, engagement, and cognitive workload) and environmental (i.e., non-immersive VR [2D], immersive VR [3D], or a physical environment [PE]) factors on acquisition, retention, and transfer to an unpracticed real-world task. Twenty-eight typically developing children aged 8-13 years acquired the skill in 1 of 3 environments (2D, 3D, or PE) and completed affect questionnaires. They returned for retention trials in the same acquisition condition; transfer trials in the opposite condition (i.e., PE to 2D/3D VR, and 2D/3D VR to PE); and transfer trials in an unpracticed real-world postural reaching task. Mixed effect models evaluated the impact of affective and environmental factors on performance in each session. In 3D VR, children reported higher motivation, engagement, and lower cognitive workload and demonstrated higher performance at the end of acquisition. However, there were no between-condition performance differences in retention, transfer, or real-world transfer. Subsequent research should further explore the impact of differing perception-action affordances in 2D and 3D VR on skill transfer.

O2.3 *A movement tracking videogame with a family-centered approach to upper limb rehabilitation for children with cerebral palsy*

Daniela Chan Viquez, *University of Toronto*
Heilyn Fernandez-Huertas, *Universidad de Costa Rica*
Ajmal Khan, *Bloorview Research Institute*
Carles Montserrat, *Universidad de Costa Rica*
Sarah Munce, *KITE-Toronto Rehabilitation Institute, University Health Network*
Darcy Fehlings, *Bloorview Research Institute*
Virginia Wright, *Bloorview Research Institute*
Elaine Biddiss, *Holland Bloorview Kids Rehabilitation Hospital*

This study aimed to assess the feasibility of implementation and probable efficacy of an 8-week, home intervention program with Bootle Blast, a motion-based videogame designed for upper limb rehabilitation, in Costa Rican children with cerebral palsy. Videorecorded (Perceived Quality Rating Scale [PQRS]) and self-reported measures (Canadian Occupational Performance Measure [COPM]) evaluating motor performance on self-identified, upper limb activities were collected using a multiple-baseline, Single-Subject Case Experimental Design for the PQRS, and pre-post measures for the COPM. Children established a weekly playtime goal and played at home for 8-consecutive weeks. Videogame logs recorded time played per week. Technical barriers were documented during weekly videocalls with a monitoring therapist. Treatment effect size and percentage of non-overlapping data were used for PQRS analysis. COPM change was interpreted based on minimally clinical importance difference. Descriptive statistics summarized videogame logs and technical barriers. Fifteen children participated and 13 completed the intervention. Children's mean total play time was 377±181 minutes. Six technical barriers in total were reported. Probable efficacy was established. Of the participants, 85% improved in > 1 PQRS activity and 100% improved on the COPM. Bootle Blast is a feasible option to facilitate access to home therapy for children with cerebral palsy.

O2.4 *Quantifying individual and contextual factors that contribute to just-right challenge in an immersive virtual reality pediatric rehabilitation task: a protocol*

Samory Houzangbe, *CHU Ste-Justine*
Yahya Zejli, *University of Montreal*
Martin Lemay, *Université du Québec à Montréal*
Danielle Levac, *University of Montreal*

One advantage of immersive virtual reality (VR) as a pediatric rehabilitation tool is its potential to engage and motivate children in sustained efforts towards skill improvement. To promote motor learning, therapists strive for a just-right task challenge level that is just difficult enough to motivate the child in persistent efforts for success. VR enables finely-graded individualized task difficulty parameters in a motivating environment, making it ideally suited for just-right challenge. While dynamic difficulty adjustment models currently personalize task difficulty based on performance results, they lack input variables relevant to the affective component (motivation, engagement, or flow) of effortful persistence. If we can measure and quantify these factors, they could be added to artificial intelligence (AI) models that use this information in real-time to individualize virtual task parameters to sustain just-right challenge. In pursuit of this long-term goal, the objectives of this paper are to propose a method to identify just-right challenge from individual and contextual factors, identify neurophysiological and subjective measurement options, and outline a research methodology to validate the method. If successful, we plan to collect data to train an AI model to identify, intervene and sustain just-right challenge for children undergoing immersive VR rehabilitation interventions.

ICDVRAT Session

Monday, July 24 15:15 - 16:00

O7.1 *Initial Development of a Conceptual Framework for Designing Rehabilitation Games*

Gordon Tao, *University of British Columbia*
Julie M Robillard, *BC Children's Hospital Research Institute*
Edward Giesbrecht, *University of Manitoba*
William C Miller, *University of British Columbia*

Rehabilitation games need to be both therapeutically beneficial and sustainably engaging. The Games for Rehabilitation Design Nexus (GARDEN) Framework is being developed to support holistic design of rehabilitation games by empowering transdisciplinary teams to readily interconnect game design and rehabilitation perspectives. This paper reports on the creation of the initial GARDEN Framework to be further refined with a diverse panel of rehabilitation game interest groups.

O7.2 *Virtual Reality Exposure in Obsessive-Compulsive Disorder: Enrichment by Smell and Touch*

Iveta Fajnerová, *National Institute of Mental Health*
Anna Francová, *National institute of Mental Health*
Barbora Darmová, *Charles University*
Pavla Stopková, *National Institute of Mental Health*
Lenka Martinec Nováková, *National Institute of Mental Health*
Martina Janíková, *National Institute of Mental Health*
Dagmar Schwambergová, *National Institute of Mental Health*
Karolína Janíková, *Charles University*

The proposed feasibility study utilizes the virtual reality application for exposure and response prevention therapy and symptom provocation in patients with obsessive-compulsive disorder (OCD). The method was designed based on a dimensional approach to OCD symptomatology divided to typical four subtypes: 'contamination/cleaning', 'symmetry/ordering', 'fear-of-harm/checking', and 'hoarding'. The ongoing feasibility study aims to test the previously validated VR software 'OCD House' in combination with additional tools and methods, particularly the olfactory stimulation and tactile gloves. These methods are applied to test their effect on perceived presence in tested virtual simulations (scenarios). We hypothesize that the tactile or olfactory stimulation during simulated VR experience will enhance the perceived level of presence and potentially also increase the evaluated intensity of the symptoms provoked by this sensory enriched VR simulation.

O7.3 *Immersive Virtual Reality vs non-Immersive Applications for Managing Chronic Cancer Pain, a Randomized Control Trial*

Bernie Garrett, *University of British Columbia*
Gordon Tao, *University of British Columbia*
Crystal Sun, *University of British Columbia*
Tarnia Taverner, *British Columbia Institute of Technology*

While cancer survivorship is growing worldwide, chronic cancer pain remains a challenge. Virtual Reality (VR) is promising for delivering non-pharmacological pain therapy. This trial evaluated the efficacy of using VR-based therapy as adjunctive pain therapy for chronic cancer pain. Participants engaged in home-based pain therapy through 4 applications involving cognitive distraction and mindfulness meditation for 30min/day, 6 sequential days per application, for 4 weeks, either in VR or a laptop control. Daily pain scores were collected via visual analog scale (VAS) for before, during, and after exposure; weekly questionnaires evaluated immersion and presence. Across Canada, 110 participants were recruited; 100 were included in the analysis. Participants in both groups experienced pain benefits (VAS decrease ≥10/100mm) over at least 1 week (43/50 VR; 37/50 control). However, linear mixed effects analysis showed no statistical difference between groups. Immersion, but not presence, differences were observed in 2 applications. Cybersickness was greater in VR for 2 applications. Therefore, 2D-display based delivery of adjunctive

pain therapy for chronic cancer pain may be similarly effective as VR. Recommendations for applications will depend on individual taste and preferences for cognitive engagement vs mindfulness meditation.

Oral Session 3: Locomotion in virtual environments

Monday, July 24 16:30 - 17:45

O3.1 *The impact of walking and visual distraction on lexical decisions in single and multitask virtual reality settings*

Eva Kehayia, *McGill University*
Naomi Vingron, *Goethe University*
Nancy Azevedo, *Jewish Rehabilitation Hospital*
Gonia Jarema, *University of Montreal*
Joyce Fung, *McGill University*
Roya Khalili, *McGill University*
Sarah Lee, *McGill University*
Anouk Lamontagne, *McGill University*
Ruthann Atchley, *University of South Florida*
Paul Atchley, *University of South Florida*
Juhani Jarvikivi, *University of Alberta*
Debra Titone, *McGill University*
Gary Libben, *Brock University*

This study investigates how walking modulates concurrently performed cognitive tasks, such as language processing and visual control in an ecologically valid, yet controlled VR setting. Participants perform a lexical decision task (LDT) that is completed as (1) a single-task+, where the participant is seated while seeing the words overlayed on a static image of a cityscape with randomly appearing visual distractors and (2) a multitask, where the same task is done while walking on a self-paced treadmill through a dynamic VR city scape. Lexical decision patterns remain consistent, but responses are modulated by the addition of concurrently performed tasks Our current findings point to an interplay of both task-related and individual characteristics determining multitask performance.

O3.2 *Using an Embodied Avatar in Immersive Virtual Reality to Increase Gait Variability in Rehabilitation: A Study in Development*

Alex Van Den Berg, *Delft University of Technology*
Laura Marchal-Crespo, *Delft University of Technology*

Research on motor learning has found evidence that movement variability is positively correlated with the rate of motor learning. Enhancing motor variability during training could therefore be a promising method to improve rehabilitation outcomes. Here, we propose the use of visual disturbances through the manipulation of an embodied avatar's foot position to induce increased movement variability during gait training using immersive virtual reality technology. Previous research has shown that modulating the movements of an embodied avatar can lead to changes in the user's movements. This effect could be exploited to induce increased movement variability in the gait pattern, potentially leading to improved gait rehabilitation outcomes. The proposed study aims to investigate the effects on movement variability and users' motivation and embodiment of inducing a noise-like disturbance to the avatar's tracked foot position in the horizontal plane while walking on a treadmill. The virtual environment that healthy participants will walk through resembles a long, shallow river visualized from a first-person perspective using a head-mounted display. Through this experiment, we will gain a better understanding of the effect of visual disturbances using embodied avatars on movement variability as a first step toward its use in rehabilitation settings.

O3.3 *Are individuals with chronic moderate to severe traumatic brain injury able to safely walk in the community? Exploring the challenges of dual-task walking while avoiding virtual pedestrians.*

Thiago De Aquino Costa Sousa, *Jewish Rehabilitation Hospital CISSS Laval – CRIR*

Bradford McFadyen, *Université Laval*

Anouk Lamontagne, *McGill University - Jewish Rehabilitation Hospital CISSS Laval - CRIR*

Individuals with a moderate-to-severe traumatic brain injury (m/sTBI) present alterations in sensorimotor and cognitive functions that can affect their ability to perform the complex walking tasks required for independent community ambulation. Whether their ability to circumvent pedestrians under single and dual-task conditions is altered, however, remains unclear. The aim of this study was to assess cognitive and locomotor dual-task costs (DTCs) in m/sTBI individuals and healthy controls (CTLs) during a collision avoidance task involving virtual pedestrians (VRPs). Twelve individuals with m/sTBI and 12 CTLs performed the collision avoidance task with VRPs, as well as a cognitive (pitch discrimination) task, under single and dual-task conditions. Overall, CTLs showed negative DTCs (performance enhancement) for all locomotor outcomes, as opposed to positive DTCs (performance deterioration) for the m/sTBI group. Under dual-task conditions, the m/sTBI group demonstrated a delayed onset of trajectory deviation and maintained a smaller minimum distance from VRPs, as opposed to the CTLs who displayed an earlier trajectory deviation and a larger minimum distance. A larger positive DTC for cognitive task accuracy was found in the m/sTBI group vs. CTLs. Individuals with m/sTBI present altered collision avoidance strategies under dual-task conditions, which may contribute to their reduced community walking abilities.

O3.4 *Gait Adaptations During Constrained Immersion: Assessing the Role of Virtual Boundaries*

Elizabeth Wilson, *Temple University*

William Wright, *Temple University*

Daniel Jacobs, *Temple University*

Santiago Canete, *Temple University*

When immersed in a virtual reality (VR) environment, users have been shown to adjust spatiotemporal gait parameters in comparison to both non-immersed overground and treadmill-based locomotion. However, these differences are highly inconsistent, and key questions remain regarding the physical and virtual contextual factors that drive them. Here, we explore how manipulating physical objects and their virtual equivalents can impact the relationship between the observable environment and the motor strategies used to ambulate through it. Five unimpaired young adults were instructed to walk at a comfortable speed under several visual conditions on a self-paced treadmill. Treadmill handrails, both virtual and physical, were either implemented or removed to manipulate visual mediolateral constraints on the participant's explorable mediolateral space. Overall, participants demonstrated relatively small adjustments to gait strategy between VR and real-world visual settings while walking on a self-paced treadmill. However, the removal of the virtual boundaries was associated with a significant increase in walking speed via increased step length and decreased step time when compared to the constrained virtual space. Together, these results demonstrate a role for strategically controlling both the walking environment and cues in the virtual space to accurately measure gait changes between virtual and real-world contexts.

Oral Session 4: Telerehabilitation

Tuesday, July 25 10:45 - 12:15

O4.1 *A Clinician-Guided Physical Movement Exergame for Individuals with Muscular Dystrophy*

Dalya Al-Mfarej, *Delsys and Altec, Inc*
Jennifer Vojtech , *Delsys and Altec, Inc*
Serge Roy, *Delsys Inc*
Elise Townsend, *MGH Institute of Health Professions*
Julie Keysor, *MGH Institute of Health Professions*
Nancy Kuntz, *Lurie Children's Hospital of Chicago*
Vamshi Rao, *Lurie Children's Hospital of Chicago*
Joshua Kline, *Delsys, Inc and Altec, Inc*
Bhawna Shiwani, *Delsys and Altec, Inc*

This study introduces a VR exergame for physical therapy and reversal of inactivity tailored for individuals with Duchenne muscular dystrophy (DMD). DMD is a rare disease that causes progressive muscle weakness and decreased opportunities for physical activity and movement. Management of the disease may require frequent clinical visits to specialized healthcare professionals for slowing the progressive muscular and cardio-respiratory effects of the disease. Limited availability and/or proximity to such resources are obstacles to optimal care and can lead to missed rehabilitation opportunities and reduced quality of life. We propose a physical activity VR game with remote telehealth applicability that incorporates: 1) shared patient-clinician VR interaction, 2) physiological sensors that provide real-time metrics of health outcomes to the patient and clinician, and 3) life-like virtual avatar interactions through depth camera body tracking technology; and 4) quantitative kinematics. The system was evaluated among 12 individuals, including 3 participants with DMD. Feedback through surveys, interviews, and focus group discussions with participants, accompanying family members, and clinicians demonstrated the feasibility of this VR tool for telehealth or as part of a home exercise program.

O4.2 *Motivation to perform telerehabilitation training: A qualitative assessment of the Home Virtual Rehabilitation System*

Gerard Fluet, *Rutgers University*
Holly Gorin, *Rutgers University*
Pamela Rothpletz - Puglia, *Rutgers University*
Qinyin Qiu, *Rutgers University*
Amanda Cronce, *New Jersey Institute of Technology*
Jigna Patel, *Rutgers University*
Alma Merians, *Rutgers University*
Sergei Adamovich, *New Jersey Institute of Technology*

Patients post-stroke utilized the Home Virtual Rehabilitation System to perform home-based, gamified UE rehabilitation over 12 weeks. Outcomes related to adherence and clinical improvement were collected, and semi-structured interviews were conducted to assess intrinsic and extrinsic motivators that impacted engagement with the system. Qualitative analysis generated seven themes that both positively and negatively influenced each subject's experience with HoVRS, including challenge as a primary intrinsic motivator and pursuing additional therapy and/or a return to higher functional status as a key extrinsic motivator. Findings were consistent with recent related literature.

O4.3 *Perspectives on Digital Health Technologies in Pediatric Care and Rehabilitation*

Isabelle Roy, *University of Montreal*
Julia Salles, *University of Montreal*
Imen Doukhane, *University of Montreal*
Danaë Larivière-Bastien, *University of Montreal*
Aurélie Blondin, *University of Montreal*
Danielle Levac, *University of Montreal*
Jérôme Gauvin-Lepage, *University of Sherbrooke*
Michelle Bourassa, *CHU Sainte-Justine*
Stéphanie Fiset, *CHU Sainte-Justine*
Karine Tadros, *CHU Sainte-Justine*
Miriam Beauchamp, *University of Montreal*

Digital health technologies are increasingly adopted by healthcare professionals working in pediatric hospital and rehabilitation settings. Multiple factors may affect the acceptance and implementation of digital health technologies in these settings. This study aimed to explore the factors that promote or hinder the use of digital health technologies (mobile learning applications, virtual/augmented reality, serious games, robotic devices, telehealth, computerized assessment tools, wearables) among pediatric healthcare professionals. An online survey documenting opinions on current use and future intentions to use digital health technologies was completed by 107 professionals at Canada's largest mother-child hospital and rehabilitation centre. T-tests and linear regression results indicate that the attitudes promoting the intention to increase the use of digital health technologies vary according to technology type. Healthcare professionals who report wanting to increase their use of digital health technologies have a more positive attitude regarding benefits in clinical practice and patient care, but are critical of the impact on patient-professional relationships. The factors that hinder successful usage are lack of training ($\hat{I}^2$=0.303; p=0.033) and inadequate infrastructure ($\hat{I}^2$=0.342; p=0.032). Study results underscore the importance of addressing training and infrastructure needs when elaborating technology-specific strategies for adopting digital health technologies.

O4.4 *Hybrid tele-rehabilitation for children: Initial results of a scoping review*

Tal Krasovsky, *University of Haifa*

Naomi Gefen, *ALYN Hospital*

Liat Gafni, *University of Haifa*

Patrice (Tamar) Weiss, *University of Haifa; ALYN Hospital*

Rachel Kizony, *University of Haifa; Tel Aviv University*

This paper describes initial results of a scoping review of hybrid tele rehabilitation of allied health professions for children. The review focuses on the characteristics and outcome measures used in 20 studies.

Oral Session 5: Sensory function and balance

Tuesday, July 25 13:45 - 15:15

O5.1 *Validation of portable VR assessments of balance and vestibulo-ocular function*

William Wright, *Temple University*

This validation study of a battery of virtual reality (VR) head-mounted display-based balance, oculomotor, and vestibular assessments compared the novel VR tests to standard validated measures currently available in clinic for evaluating individual with signs or symptoms following a concussion. Forty-eight healthy adults except for having a history of concussion (n=18), were tested in both standard and novel VR assessments. Correlation coefficients revealed that the VR balance significantly correlated with the gold-standard SOT posturography measure (r=0.300-0.672, p< 0.01), the VR vestibular assessment correlated with the traditional measure of dynamic visual acuity (r=0.570, p=0.014), and the VR measure of near-point convergence correlated with the manual measure (r = 0.454, p< 0.001). Comparing those with a history of concussion to those without, revealed no between group difference. The current findings support criterion measure validity. Further testing is needed to establish sensitivity to visual, vestibular, or balance deficits.

O5.2 *Acceptance and Usability of the c-VVAS: A new tool to evaluate Visual Vertigo*

Joyce Fung, *McGill University*

Alessia Vitullo, *McGill University*

Yunyi Liu, *McGill University*

Elizabeth Dannenbaum, *Jewish Rehabilitation Hospital*

Anouk Lamontagne, *McGill University*

Visual vertigo (VV) is a common symptom in people with persistent postural-perceptual dizziness (PPPD). A few subjective scales have been validated for assessing the intensity of VV, yet they are limited by

recall bias, as they require individuals to rate their symptoms from memory. The aim of this pilot study was to develop and test a computerized, video-based tool for the assessment of VV in people with PPPD. The Computerized Video-based Visual Vertigo Analogue Scale (c-VVAS) was developed by adapting five scenarios from the original paper-pencil version, VVAS (PP-VVAS), developed by Dannenbaum et al. (2011). In this pilot study, PPPD participants (n=8) and age- and sex-matched controls (n=8) rated their level of dizziness using the PP-VVAS and the c-VVAS. Participants also reported on their experiences using the c-VVAS using a questionnaire developed based on the Technology Acceptance Model (TAM) and open-ended questions. We conclude that the c-VVAS is highly accepted and can be used as a realistic and convenient clinical assessment tool.

O5.3 *Attractive and Repulsive vibrotactile biofeedback during balance-cognitive multitasking*

Katrin Schulleri, *Technical University of Munich*
Farbod Feizian, *Technical University of Munich*
Leif Johannsen, *Technical University of Munich*
Dongheui Lee, *Technische Universität Wien*

Directional vibrotactile biofeedback for balance control can be encoded in form of a Repulsive (instructing to move in the opposite direction of vibrations) or Attractive (instructing to move in the direction of vibrations) signals. However, which of these encodings is less cognitively demanding, remains unresolved. We compared in 32 healthy young adults the effect of Attractive and Repulsive vibrotactile biofeedback not only on balance control, but also on cognitive load during balance-cognitive multitasking with different difficulty/complexity (simple: choice reaction time task, CRT; difficult: two-back task, 2back). Trunk motion reduced ($p_{adjusted} \leq 0.001$) and percentage of time spent within the deadzone (Time-in-DZ; feedback inactive) increased ($p_{adjusted} \leq 0.001$) due to feedback in both Attractive and Repulsive group (n per group: 15; 8 females, 7 males). Though, Time-in-DZ reduced in the 2back task compared to the CRT. Further, the cognitive load measured with the linear integrated speed accuracy tradeoff increased in the Attractive group ($p_{adjusted} \leq 0.01$) and in the 2back task ($p_{adjusted} \leq 0.001$), which together with the still improved balance control indicates a prioritization of posture (posture-first principle). As interference between balance control with vibrotactile feedback was lower in the Repulsive encoding, we would suggest that Repulsive encoding is a better choice for use in daily life.

O5.4 *Differential responses of chronic pain phenotypes during virtual reality exposure: a pilot study*

Alexandra Canori, *Temple University*
William Wright, *Temple University*
Donna Coffman, *University of South Carolina*
Shivayogi Hiremath, *Temple University*

Chronic pain affects the majority of individuals with spinal cord injury (SCI) and interferes with function and quality of life. The objective of this study was to evaluate the responses between chronic pain and exposure to virtual reality (VR) in two phenotypes of pain. This study was conducted in 17 individuals with SCI who engaged with VR for a five-minute and ten-minute bout. Pain intensity ratings were assessed at baseline and after each bout of VR. Both pain phenotypes reduced with VR exposure, however differences between pain phenotypes were observed. A decrease in neuropathic pain was achieved within a five-minute bout, and this decrease was maintained at the end of the VR sessions, whereas no change in nociceptive pain level was observed once the VR exposure was completed. These findings suggest that different mechanisms of pain modulation are activated through VR exposure in each pain phenotype.

Oral Session 6: Aging and Cognition

Tuesday, July 25 16:15 - 17:45

O6.1 *Exercise Intensity in a Virtual Bicycling Environment: Comparing Findings between Young and Older Healthy Adults (VCYCLE-Competition)*

John Palmieri, *Rutgers New Jersey Medical School*
Judith Deutsch, *Rutgers School of Graduate Studies*

The effects of aging on the response to competitive exercise may provide insight into exercise strategies for healthy adults across the lifespan. Fifty healthy adults (25 young, 25 older) bicycled in 3 fully immersive virtual environments (VE). Two of the conditions used competitive stimuli of other bicycle riders in the VE to drive exercise intensity, differing only in the instructions provided to the participant. The 3rd condition used road markers that changed color as visual feedback to increase cycling cadence. Findings from the three 5-minute exercise bouts indicate that young adults bicycled at a faster raw cadence in the 2 competitive conditions compared to older adults. However, there were no significant differences in normalized cadence or any other measures of exercise intensity comparing young to older adults. For both young and older healthy adults, exercise intensity (heart rate and cycling cadence) was higher in both competitive conditions compared to feedback. These findings may partially be explained by the high levels of competitiveness in each population. Therefore, VEs incorporating competitive exercise may be useful for driving exercise intensity in healthy adults across the lifespan.

O6.2 *Home Virtual Rehabilitation for Early Alzheimer's or Chemobrain: Two Case Studies*

Grigore Burdea Phd, *Bright Cloud International Corp*
Kevin Polistico, *Bright Cloud International Corp*
Daniel Nguyen, *Bright Cloud International Corp*

Cognitive deficits from Alzheimer's disease (AD) or those subsequent to chemotherapy are not well addressed in the Standard of Care. The novel BrightGo system, when used at home, may provide an alternative therapy to address these Healthcare gaps. BrightGo consists of a modified Head Mounted Display, a Galvanic Skin Response sensor, a laptop, a router and a library of custom therapeutic games. Case 1, a 77 year old female in the early phase of AD and Case 2, a 66 years old breast cancer survivor post chemotherapy, underwent BrightGo home training for 8 weeks and were followed for another 8 weeks. Both improved on several cognitive measures, something maintained at follow up. At 16 weeks Case 2 depression severity had reduced by twice the minimal clinical important difference vs. baseline.

O6.3 *Development of Multimodal Motion-Assisted Memory Desensitization and Reconsolidation (3MDR) Therapy for Multi-platform Use*

Jacob Van Dehy, *Naval Health Research Center*
Vrajeshri Ordek, *Naval Health Research Center*
Rasmus Grunnet-Jepsen, *Naval Health Research Center*
Emmanuel Espejo, *Leidos*
Anne Gerhart, *Naval Health Research Center*
Pinata Sessoms, *Naval Health Research Center*

As researchers continue to create novel and innovative virtual reality (VR) based rehabilitation applications, there is a parallel need to make these developments accessible to clinicians with varying levels of available tools and skill sets. Here, we outline our work towards converting Multimodal Motion-Assisted Memory Desensitization (3MDR) therapy for posttraumatic stress disorder from exclusive VR technology to more accessible VR and augmented

reality (AR) platforms. In this work, we highlight the technological considerations of developing an environment across multiple platforms and highlight user interface development (both for patient and therapist user experience). Our work has resulted in a single software capable of being deployed to multiple VR and AR platforms that are actively being used at multiple sites internationally. While continuous feedback from patients, clinicians, and researchers will be incorporated into the program, this work creates a software basis for expanding 3MDR therapy to a wider range of patients and therapists.

O6.4 *Can we capture posture with a mobile phone?*

Omer Dilian, *University of Haifa*
Asaf Levy, *Technion, Israel Institute of Technology*
Ron Kimmel, *Technion, Israel Institute of Technology*
Maayan Agmon, *University of Haifa, Cheryl Spencer Department of Nursing*

Postural changes throughout the lifespan are important indicators of overall health and well-being. Currently, the most accurate method for evaluating posture relies on the use of Vicon, a system that is not readily available in clinical settings. The aim of this pilot study was to explore the potential of 3D scans conducted using smartphone sensors as a means of assessing posture and to validate this method against the gold standard, Vicon. Our preliminary results demonstrate that a simple photogrammetric tool can assess posture and estimate age accurately. Thus, photogrammetric methods in telerehabilitation and interventions can aim at slowing and preventing age-related declines. Further research is needed to fully establish the efficacy of this approach.

06.5 *Supporting Caregiver Empathetic Disposition Through Virtual Experiences To En-Hance Quality Of Life In People Living With Dementia*

Francesca Morganti, *University of Bergamo*

The care for people with dementia is frequently delegated to informal caregivers (e.g., relatives) with no useful knowledge to manage their care receiver. The situation's recurring nature puts them at risk for emotional distress. We present an online psychoeducational program that incorporates an immersive 360° video experience included in the ViveDe program. The main aim of the project is to reduce caregivers' perceived stress by acting on the cognitive components of empathy through the presence effect possible by ViveDe combined with a psychoeducational approach.

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