HUMAN ENGINEERING RESEARCH LABORATORIES

HERL Quarterly Newsletter

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LETTER FROM THE EDITOR

Hello again! HERL would like to thank everyone for the feedback we have received from our readers, colleagues, and research participants regarding our new newsletter. This is only our second issue, but we've been pleased at the positive reactions you have shared with us. As always, we are open to new ideas on how to disseminate our research findings as well as the latest news on what's going on at HERL.

The HERL Advisory Board panel hard at work. *From left*: Ziggy Landsman (EPVA), Tom Stripling (PVA), Michael Boninger (HERL), Dayne Greene. *Front*: Paula Stankovic (HERL). *Back*: John Chlebowski (KPVA), Ian Rice and Jessica Davenroy (University of Washington), Mike Capp (HERL), Michael Scheller (University of Washington)

The Human Engineering Research Laboratories investigators, students, and staff have been very busy lately! We held a center **Advisory Board Meeting** on March 14th and 15th to evaluate our progress on our VA Center of Excellence for Wheelchair and Related Technology and the University of Pittsburgh Model Center on Spinal Cord Injury. We invited a panel of fellow researchers, research participants, and delegates from organizations representative of our research such as Paralyzed Veterans of America (PVA), Keystone Paralyzed Veterans of America (KPVA), and Eastern Paralyzed Veterans of America (EPVA). The advisory board provided valuable insight and suggestions on the many research and administrative projects going on at HERL during the two day meeting.

The HERL students and faculty have also been busy getting ready to attend the **2002 RESNA (Rehabilitation Engineering and Assistive Technology Society of North America) conference** on June 27-July 1 in Minneapolis. Twenty-five papers from HERL were accepted for presentation at the conference; four HERL students won the RESNA-Whitaker Foundation Student Scientific Paper award and one student earned an honorable mention. We have featured the abstracts from these award-winning RESNA conference papers in this issue of the newsletter.

Immediately after the RESNA conference, HERL investigators and students will be rushing off to the **22nd National Veterans Wheelchair Games** from July 9-13th in Cleveland. HERL has attended the games for the past three years to help disseminate our research as well as recruit wheelchair users outside of Pittsburgh to participate in our research studies.

We hope you enjoy this issue of the newsletter and we thank you for your continued support!

Editor, HERL Quarterly Newsletter

HERL director Dr. Rory Cooper won first place in the slalom competition and 5 gold medals at the 2001 Games in New York City.

INSIDE THIS ISSUE:

CURRENT RESEARCH ABSTRACTS:
HERL'S 2002 RESNA-WHITAKER FOUNDATION STUDENT SCIENTIFIC PAPER AWARD WINNERS

Effectiveness of Rear Suspension in Reducing Shock Exposure to Manual Wheelchair Users During Curb Descents

Andrew M Kwarciak, BSE, Rory A Cooper, PhD, Erik J Wolf, BSE

Andrew M. Kwarciak, B.S.E.

Purpose of the Work. In response to studies demonstrating the negative effects of whole-body vibrations, manufactures of manual wheelchairs have added rear suspension elements to their designs. The resulting wheelchairs have been brought to market; however, no data are available to assess their effectiveness. The purpose of this study is to determine whether suspension wheelchairs reduce the transmission of whole-body vibrations. **Procedures**. Six different manual wheelchairs, three rear suspension chairs (Colours Boing, Invacare A6S, and Quickie XTR) and three folding x-brace chairs (E&J Epic, Invacare Action Xtra, and Quickie 2) were used to evaluate the effectiveness of rear suspension in reducing shock transmissibility. A test pilot was asked to descend three different height curbs (50mm, 100mm, and 150mm) with each of the six wheelchairs. Data was collected from an accelerometer, mounted on the seat of each wheelchair. **Results**. Statistical analysis showed no difference between the accelerations of suspension and folding x-brace wheelchairs during the curb descents. It was suggested that due to the poor alignment of the suspension units during the curb descents, the suspension chairs were unable to reduce shock vibrations. The Quickie XTR was the only chair that demonstrated a noticeable level of vibration reduction; however in doing so, it shifted the frequencies of the seat accelerations into a potentially harmful range for wheelchair users. **Relevance to wheelchair users:** Throughout the course of daily activities, wheelchair users experience quick, high magnitude loads during curb descents, thereby increasing their vulnerability to secondary spinal injuries. Recognition of this situation has resulted in recent approaches to vibration reduction. However current manual suspension wheelchairs do not provide users with improved vibration reduction during curb descents.

Wheelchair Propulsion Biomechanics In Patients With Multiple Sclerosis

Fabrisia Ambrosio, MPT, Michael Boninger, M.D., Brian Fay, Ph.D., Aaron Souza, M.S., Alicia Koontz, Ph.D., Rory Cooper, Ph.D.

Fabrisia Ambrosio, M.S., MPT

Purpose of the Work. The objective of this study was to characterize wheelchair propulsion in patients with multiple sclerosis (MS). **Procedures.** A biomechanical analysis of wheelchair propulsion was completed in individuals with MS and in individuals with spinal cord injury (SCI), with 15 subjects in each group. The MS and SCI groups used their own manual wheelchair when possible. Otherwise, they were given a wheelchair from the laboratory to use for the testing. Measurements were taken using bilateral Smart^{Wheels}, capable of measuring three-dimensional applied forces at the pushrim during wheelchair propulsion. Each subject performed a 1m/sec speed trial for twenty seconds. **Results.** Our study found that, when compared to individuals with paraplegia, individuals with MS propelled their wheelchairs at a slower velocity, despite feedback to maintain speed. In addition, they produced higher propulsive forces. A quantifiable amount of energy was lost at the beginning and end of the push phase of propulsion in individuals with MS. Further research should investigate ways in which clinicians can help individuals with MS become more functional manual wheelchair users.

CURRENT RESEARCH ABSTRACTS:
HERL'S 2002 RESNA-WHITAKER FOUNDATION STUDENT SCIENTIFIC PAPER AWARD WINNERS

Trunk Movement Adaptations During Wheelchair Propulsion at Two Speeds and Load Conditions

Yu-Sheng Yang, M.A., Alicia M. Koontz, Ph.D, Rory A. Cooper, Ph.D., Michael L. Boninger, M.D.

Yusheng Yang, M.A.

Purpose of the work. Manual wheelchair propulsion has been recognized as a strenuous method of locomotion. Due to this characteristic, inappropriate wheelchair propulsion technique might result in overuse injuries and reduced efficiency. The purpose of this study was to observe trunk movement adaptations when manual wheelchair users (MWUs) were faced with varying propulsion conditions. **Subjects/Procedures.** Eight Manual wheelchair users participated in this study. The participants were tested on a wheelchair dynamometer, which was used to simulate various propulsion conditions. A three-dimensional camera system was used to record the subject's right acromion process and wheelchair hub to identify their coordinate positions in a global frame of reference during four different propulsion conditions. Degree of trunk oscillation was calculated as the difference between maximum and minimum trunk flexion angle for each stroke. **Results.** Our results indicated that MWUs leaned their trunk forward to meet the physical demands of increased load and speed. More trunk range of motion at the faster speed condition was found. **Relevance to Wheelchair Users.** Our findings indicate that MWUs use trunk movement adaptation when facing difficult propulsion conditions. Information regarding the extent of trunk movement during propulsion could be valuable in understanding the relationship between mechanical efficiency and propulsion style.

Comparison Of Hybrid III ATD And Wheelchair User At Selected Speeds

Mike Dvorznak, B.S., Rory Cooper, Ph.D., Michael Boninger, M.D.,
Shirley Fitzgerald, Ph.D, Tom Corfman, M.S.

Michael J. Dvorznak, B.S.

Purpose of the work. The goal of this study was to determine if a modified 50th percentile male Hybrid III anthropomorphic test dummy (HTD) has a similar dynamic response as a wheelchair user with a spinal cord injury during low speed, low impact scenarios. **Procedures.** A HTD typically used in vehicle crash testing was modified to simulate a person with lower extremity paralysis. The test dummy was placed in a Quickie P100 powered wheelchair. The wheelchair was driven at three speeds and three braking conditions were used to slow the wheelchair to a stop. The trunk motion of the HTD was recorded and compared to the motion of a wheelchair user with T8 paraplegia under the same wheelchair braking conditions. **Results.** The trunk angular motion (displacement, velocity, and acceleration) of the wheelchair user and HTD were similar over a range of speeds and braking impulses. This indicates that the test dummy can be a suitable surrogate for a wheelchair user in low speed dynamic studies.

Relevance to wheelchair users. Development of a test dummy with comparable characteristics to a wheelchair user population can be used in studies to reduce the frequency and severity of wheelchair accidents.

RECENT HERL PUBLICATIONS AND PROCEEDINGS

Cooper RA, Corfman TA, Fitzgerald SG, Boninger ML, Spaeth DM, Ammer W, Arva J, Performance Assessment of a Pushrim Activated Power Assisted Wheelchair Control System, **IEEE Transactions of Control Systems Technology**, Vol. 10, No. 1, pp.121-126, January 2002.

Cooper RA, Thorman T, Cooper R, Dvorznak MJ, Fitzgerald SG, Ammer W, Song-Feng G, Boninger ML, Driving Characteristics of Electric Powered Wheelchair Users: How Far, Fast, and Often do People Drive?, **Archives of Physical Medicine and Rehabilitation**, Vol. 83, No. 2, pp. 250-255, February 2002.

Mills T, Holm MB, Trefler E, Schmeler M, Fitzgerald SG, Boninger ML, Development and Consumer Validation of the Functional Evaluation in a Wheelchair (FEW) Instrument, **Disability and Rehabilitation**, Vol. 24, No. 1, pp. 38-46, January 1, 2002.

Cooper RA, Baldini FD, Boninger ML, Cooper R, Physiological Responses to Two Wheelchair Racing Exercise Protocols, **Neurorehabilitation and Neural Repair**, Vol. 15, No. 3, pp. 191-195, 2001.

Arva J, Fitzgerald SG, Cooper RA, Boninger ML, Mechanical Efficiency and User Power Requirement with a Pushrim Activated Power Assisted Wheelchair, **Medical Engineering and Physics**, Vol. 23, No. 10, pp. 699-705, December 2001.

Cooper RA, Cooper R, Boninger ML, 20 Years and Still Going Strong: 20th Annual Survey of Lightweight Wheelchairs, **Sports 'N' Spokes**, Vol. 28, No. 2, pp. 35-45, March 2002.

Schmeler M, Boninger ML, Cooper R, Burden of Proof: Use Evidence to Justify Wheelchair Seating Interventions, **Advance for Directors in Rehabilitation**, Vol. 11, No. 2, pp. 25-26, February 2002.

Cooper RA, Editorial on "Wheelchair Users are not Necessarily Wheelchair Bound", **Journal of the American Geriatrics Society**, pp. 771-772, Vol. 50, No. 4, April 2002.

HERL IN THE MEDIA

VA Research Currents, Vol. 2, No. 1, January 2002, Page 3: Research Proposals Sought For Veterans Special Events

Pitt Campaign Chronicle, February 18, 2002, Page 6: Pitt Recieves $1.7 Million Grant to Study Upper Limb Pain

Pittsburgh Post Gazette, February 25, 2002: Cotillion for a Cause

Pitt Magazine, March 1, 2002, Page 14: Gold Medal Winner

Pittsburgh Business Times, March 15, 2002, Page 8: 2002 Health Care Hero Awards: Innovations award, Michael Boninger

University Times, April 4, 2002, Page 15: Journals by Faculty and Staff: Rory Cooper

MEET THE INVESTIGATOR: MICHAEL L. BONINGER, M.D.

Michael L. Boninger graduated from Ohio State University with both a medical doctorate and a degree in Mechanical Engineering. He received his specialty training in Physical Medicine and Rehabilitation at the University of Michigan Medical Center where he served as Chief Resident. After his residency program, he completed a National Institutes for Disability and Rehabilitation Research (NIDRR) Fellowship in Assistive Technology at the University of Pittsburgh. Currently, Dr. Boninger serves as the Medical Director of the Human Engineering Research Laboratories and the director of the University of Pittsburgh Model Center on Spinal Cord Injury (UPMC-SCI), funded by NIDDR. In addition, he is the Executive Director of the University of Pittsburgh Medical Center's Center for Assistive Technology and Associate Professor and Research Director in the Department of Physical Medicine and Rehabilitation. Dr. Boninger also holds appointments in the Department of Rehabilitation Science and Technology and the Department of Bioengineering and works as a physician researcher for the Department of Veterans Affairs.

Dr. Boninger serves as the Medical Director for the Human Engineering Research Laboratories

Dr. Boninger's work focuses on all aspects of assistive technology. He specifically focuses on upper extremity pain in individuals who rely on manual wheelchairs for mobility, telerehabilitation, multiple sclerosis, and assistive technology service delivery. Dr. Boninger has over fifty peer reviewed journal publications and numerous book chapters and extended abstracts in these research areas.

In March, Dr. Boninger received the 2002 Pittsburgh Business Times Healthcare HERO Award for Innovation and Research. He also received the Young Academician Award of the Association of Academic Physiatrists in 1998. Dr. Boninger serves on the editorial board of the Archives of Physical Medicine and Rehabilitation and the Journal of Rehabilitation Research and Development.

CURRENT EVENTS

The 22nd **National Veterans Wheelchair Games** will take place from July 9-13, 2002 in Cleveland, OH. For more information, please visit the official Games website: http://www.va.gov/vetevent/nvwg/2002

If you know of a current event that you would like to post in the HERL Quarterly Newsletter, please contact Christine Heiner at (412) 365-4854 or by e-mail at heinercm@pitt.edu

July 22, 2002 is **"Wheelchair Day" at Kennywood Park** in West Mifflin, Pa. For more information, please contact Kennywood Park events at 412-461-0500.

Fishing Has No Boundaries, Inc. will hold it's **annual fishing event** in Sandusky, OH on August 17-18, 2002. The event is open to all people with disabilities. For more information about the event or becoming a member of FHNB, please visit their website: http://www.fhnbinc.org or contact Kris Bauer at 419-684-9866 or by e-mail at fhnbsoc@aol.com.

The 2nd Major League Wheelchair Softball Tournament , featuring some of the top wheelchair softball teams in the country, will take place at Shea Stadium in New York on **September 20-21, 2002.** For more information, contact EPVA at (718) 803-3782 ext 274 or 309, or visit their website at www.epva.org.

FEATURED HERL STUDENT: SEAN REEVES

Sean A. Reeves earned his Bachelor of Science in Exercise Science from the University of Texas in Arlington in 1999. In September of 2000 he joined the Human Engineering Research Laboratories and the Department of Rehabilitation Science and Technology (RST) at the University of Pittsburgh. He is pursuing a Masters of Science in RST with a concentration in biomechanics. Sean has worked on HERL research projects such as Road Loads II, the MS study, and currently has a lead role in the GAME^{Cycle} project. GAME^{Cycle} is an upper extremity exercise device for wheelchair users that uses computer game-play as a motivator to encourage adherence to an exercise program. Sean won the RESNA-Whitaker Student Scientific Paper Award in 2002 for his submission on the GAME^{Cycle} project entitled, "Determining the Effectiveness of the GAME^{Cycle} System as an Exercise Device" (abstract appeared in the January 2002 newsletter). He expects to graduate from the University of Pittsburgh in December of 2002. Sean also holds a certificate in Personal Training, and enjoys running, and golfing in his spare time.

Article Written by Erik Wolf, B.S.

IN MEMORY OF THOMAS J. O'CONNOR, PH.D.

In March the Human Engineering Research Labs learned of a great tragedy: Tom O'Connor, a close friend and recent doctoral graduate, had passed away in Houston, Texas. Tom worked on his Master's degree with Rory Cooper at the California State University of Sacramento. He came to HERL to earn his Ph.D. when Dr. Cooper joined the University of Pittsburgh in 1993. Tom was a student at the Human Engineering Research Labs from 1995 until the spring of 2001, when he earned his Ph.D. in Rehabilitation Science and Technology. After graduation, he took an Assistant Professor position at Texas Technical University in Lubbock, Texas. Tom moved on to work with Dr. Arthur Sherwood at the Houston VA Rehabilitation Research and Development service soon after. He was the author of six peer-reviewed scientific journal publications.

Tom's HERL dissertation research project was the GAME^{Wheels}, a device that allows a wheelchair user to play video games by propelling their wheelchair on a roller system. The practicality of the GAME^{Wheels} system is to encourage exercise and improve cardiovascular fitness among people with disabilities. Tom developed a close rapport with the people who participated in the GAME^{Wheels} study as well as the participants of many other HERL studies. Being a person with a disability himself, Tom had a unique understanding of both the research as well as the people that participated in it. Tom, who was known for his wise-cracking, jokester persona, was a close friend to many students, faculty, and staff and was well liked by many employees at the VA Pittsburgh Healthcare System.

HERL held a memorial service for Tom on March on March 13th. Tom will be fondly remembered and tremendously missed by everyone who had the experience of knowing him.

Article written by Christine Heiner

HERL to attend the 2002 NVWG in Cleveland

The National Veterans Wheelchair Games were started in 1981 by the Department of Veteran's Affairs (VA). The VA and Paralyzed Veterans of America (PVA) have co-sponsored the games, which has become the largest annual wheelchair sporting event in the country, since 1985. The goal of the games is to introduce veterans with disabilities to a variety of wheelchair sports as well as provide competition for experienced veteran wheelchair athletes. The annual competition lasts a week and incorporates over 15 events, including archery, track and field, swimming, weightlifting, basketball, and quad rugby.

HERL Director Rory Cooper (right) won a Bronze medal at the 18th NVWG in 1998

The Human Engineering Research Laboratories has been a part of the Games almost every year. Dr. Rory Cooper, director of HERL, has competed in the games since 1983 and has won well over 100 medals. Dr. Cooper and HERL helped to host the 1998 NVWG in Pittsburgh. In 2000, Dr. Cooper brought some of his staff and researchers to the Games in San Antonio to bring HERL research to the veterans. Projects such as the GAME^{Cycle} were popular among the wheelchair athletes and HERL was invited back. HERL attended the 2001 Games in New York City and will be at the upcoming 2002 Games in Cleveland in July.

This year, HERL plans to conduct several research studies at the games. The datalogger study involves a device that is mounted on to a wheelchair and collects information on the speed, distance, and movement time of the chair as the person goes about their daily activities. The feedback study involves surveys that will collect information on wheelchair users such as demographics and wheelchair statistics that will aid in future research studies. HERL also plans to conduct a kinetic analysis study in which manual wheelchair users will propel their chairs across common surfaces such as carpet and tile.

Article written by Christine Heiner

RESEARCH PARTICIPANT SPOTLIGHT: DAYNE GREENE

Dayne Greene, one of our first research subjects, has always been willing and eager to participate in studies at the Human Engineering Research Laboratories. Dayne earned his MBA from the University of Pittsburgh in 1999 and his M. Ed. From Dusquesne University in 2001. In the summer of 2002, he moved to Kapaa on the island of Kauai, Hawaii. Dayne works as a counseler at Kapaa Middle School, where he is responsible for academic advising, behavior modification, and peer-mediation. Dayne enjoys photography, music production, fishing, traveling, writing, and cooking.

Dayne Greene

Because of his avid involvement in many of HERL's research studies, we invited Dayne to be on the HERL advisory board for the 2-day meeting in March (see article, pg.1). Dayne traveled all the way from Hawaii to Pittsburgh for the meetings, where he contributed valuable input on how to improve research dissemination and recruitment efforts. Dayne, who has always been enthusiastic about helping HERL research, also participated in our Biolab and Isokinetic Strength studies during his short stay in Pittsburgh.

Article by Christine Heiner

Human Engineering Research Laboratories

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www.herlpitt.org

Interested in Participating in a HERL Research Study?

Currently, we are actively recruiting participants for a number of different research studies. Participation is based upon inclusion criteria specific to each study. We have studies that include individuals who utilize manual or power wheelchairs as a means for mobility. The majority of our studies involve a visit to the Human Engineering Research Laboratories located at the VAMC-Highland Drive, however, some of our studies are survey based and do not involve a trip to the VAMC and there are a few exceptions. Recruitment remains ongoing for these studies and future studies. At this time we are actively seeking participants who have a spinal cord injury of above C7 for studies that involve the testing of a push rim activated power assist manual wheelchair (PAPAW) and the testing of an FDA approved wheelchair mounted robotic arm. We're also looking for people who use an electric powered wheelchair as their primary means of mobility to help test a newly developed force sensing joystick. We are actively recruiting individuals with multiple sclerosis, cerebral palsy, and SCI into additional research studies. If you would like to more information regarding the research studies or if you would like to know what studies you would qualify for, please feel free to contact the Clinical Coordinators at HERL for complete details regarding the current and future research studies.

If you're interested in participating in a HERL Research Study, Contact Rosemarie Cooper, Tricia Thorman, or Annmarie Dobson at (412) 365-4850.

Tricia Thorman, MOT, OTR/L