



HERL Quarterly Newsletter

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LETTER FROM THE EDITOR



Rory Cooper receiving the Paul B. Magnuson Award from VA RR&D Deputy Director Patricia Dorn

We have a lot of news to report since the summer issue of the HERL newsletter. First and foremost, we are proud to announce that our VA Center of Excellence for Wheelchairs and Related Technology grant proposal was renewed for another five year term. The VA Center is our biggest grant, providing \$4.25 million in research funding for July 1, 2004 to June 30, 2009.

Dr. Cooper received the Paul B. Magnuson Award at this year's RESNA Conference in Atlanta. The

Magnuson award, which is the highest award given by the Department of Veterans Affairs for Rehabilitation Research and Development, is given "in Recognition of



HERL Ph.D. students Sandra Hubbard, Andrew Rentschler, and Michael Dvorznak were awarded VA Predoctoral Fellowships this summer.

Outstanding Rehabilitation Research Dedicated to Seeking New Knowledge to Benefit the Nation's Veterans." Dr. Cooper was given the award for "pioneering work in coalescing contemporary knowledge across multiple disciplines and for selfless dedication for building careers of young scientists within the VA Health-care System."

Many of our students also received awards this summer. The VA awarded HERL doctoral students Sandra Hubbard, Andrew Rentschler, and Michael Dvorznak with Pre-doctoral fellowships for 2003-2004. HERL doctoral student Yusheng Yang won a Student Scientific Paper Travel Award from the American Society of Biomechanics to attend their annual meeting in September. HERL doctoral student

Peter Hunt received a 2003 "40 under 40" award from the Pittsburgh Urban Magnet Project. This award recognizes 40 talented people under the age of 40 who are making a positive impact on the region's development.

This summer was marked by yearly HERL activities such as the RESNA conference in June in Atlanta, GA. We continue to feature abstracts from this year's crop of HERL RESNA papers in this issue of the newsletter. This July, HERL researchers participated in the 2003 National Veterans Wheelchair Games in Long Beach, California. (See article, page 6). A team of HERL students also participated in the Three Rivers Adaptive Sports Water Ski Clinic at Conneaut Lake in July.

HERL would also like to note that we had a talented group of undergraduate interns who kept our research projects moving along smoothly this summer. HERL would like to specifically thank summer intern Eric Wood for all his assistance with the HERL newsletter.

As always, thank you to all our readers who continue to take interest in our research. - Christine Heiner Editor, HQN

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HERL students at the TRAS Water Ski clinic in July: (Clockwise, from top): Jeremy Puhlman, Beth Ann Kamiski, Stephanie Martin, Anna Allegretti, Ian Rice, David Algood, Emily Zipfel, and Elyn Tovey, (CAT)



The 2003 HERL Summer Interns: (Back Row, L to R) Alex Bevly, Abby Shoemaker, Roland Frisch, Erika Franzen, Shannon Hellestead, Garret Grindle, Joe Ulerich, Marcus Landon, Seth Ammer, Eric Wood. (Front Row, L to R) Katie Fronczak, Erin Aghamedhi, Cleo Nacopoulos. Not in photo: Shira Feigelstein

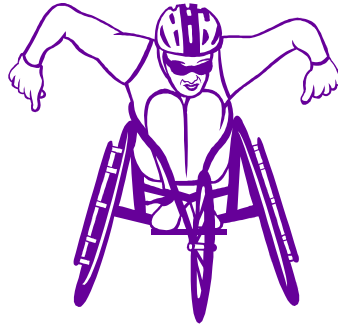
CURRENT RESEARCH ABSTRACTS

Wheelchair Racing Efficiency

Rory A. Cooper, PhD., Michael L. Boninger, M.D., Rosemarie Cooper, MPT.,
Rick N. Robertson, PhD., and Fred D. Baldini, PhD

Purpose of the Work. For individuals with disabilities exercise, such as wheelchair racing, can be important for community reintegration, as well as health promotion. The purpose of this study was to examine selected parameters during racing wheelchair propulsion among a sample of elite wheelchair racers. It was hypothesized that blood lactate accumulation, and wheeling economy would increase with speed and that gross mechanical efficiency would reach an optimum for each athlete.

Subjects/Procedures. Twelve elite wheelchair racers with paraplegia participated in this study. Nine of the subjects were males and three were females. Each subject used his or her personal wheelchair during the experiments. A computer



monitored wheelchair dynamometer was used during all testing.

Results. The blood lactate inflection point is a good indicator of the anaerobic threshold during steady-state exercise. The inflection point for our athletes occurred between 6.3m/s and 7.2m/s. The results of this study show that both economy and blood lactate concentration increase linearly with speed if resistance is held constant. The results indicate that at the higher speeds propulsion, for example near racing speeds, analysis of respiratory gases may not give a complete energy profile.

Relevance to Wheelchair Racers. While we have a good understanding of training methods to improve cardiovascular fitness, we know little about improving efficiency (e.g., technique, equipment), therefore methods need to be developed to determine efficiency while training or in race situations.

-Rosemarie Cooper, MPT, PT

Kinetic Analysis of Wheelchair Propulsion for Various Surface and Ramp Conditions

Kazuaki Ebihara, BS, Alicia Koontz, PhD, Rory Cooper, PhD, Brad Impink, BS, Michael Boninger, MD



In this study, we measured the force needed to propel one's wheelchair across various surfaces, ramps, and to 'wheelie' for 10 feet

Purpose of the Work. Many manual wheelchair users experience wrist and shoulder problems due to the repetitive use of their upper body. The purpose of this study was to determine the forces required to propel a wheelchair across various surfaces, wheelie

for 10 feet, and push up and coast down a ramp.

Subject/Procedures. This study took place during the National Veterans Wheelchair Games, July 9-13, 2002, in Cleveland, Ohio. Eleven participants with paraplegia and tetraplegia provided informed consent. Their average age and years post injury were 53.4 and 22.0 years, respectively. The participant's manual wheelchairs were fitted with a device

called the SMART^{wheel} which is capable of measuring the propulsion forces. The participants pushed along a course consisting of various surfaces such as low pile carpet, shag carpet, smooth concrete indoor tile, rough indoor tile, outdoor tile, wood flooring, and grass. They also popped a wheelie and traveled 10 feet on smooth indoor tile and pushed up and coast down a ramp. Force data were recorded and compared between all the conditions.

Results. Pushing up a ramp, across grass and outdoor tile, and wheelie-ing 10 feet required one and half to two times more force than pushing over smooth level ground.

Relevance to Wheelchair users. Wheelchair users who frequently push up ramps and over various uneven, rough surfaces are likely at a higher risk for developing wrist and shoulder problems due to the high forces involved.

-Kazi Ebihara, B.S.

CURRENT RESEARCH ABSTRACTS

Dynamic Model for Validation of a Modified Hybrid III ATD as a Test Surrogate in Wheelchair Research

Michael Dvorznak, M.S., Rory Cooper, Ph.D., Tom Corfman, M.S.

Purpose of the Work. It is estimated that there are 85,000 serious wheelchair accidents annually, of which 80% are attributable to tips and falls. Test dummies provide an ethical and practical alternative to subjects when assessing the risks and prevention mechanisms of tips and falls in controlled studies. The purpose of this study was to determine if a modified Hybrid III anthropomorphic test dummy (HTD) would have similar motion to a wheelchair user with paraplegia when seated in a decelerating power wheelchair.

Subjects/Procedures. A HTD was modified to emulate a person with a spinal cord injury. A wheelchair user with T8 paraplegia was the basis of comparison. Subjects were seated in a power wheelchair. A test operator drove the power wheelchair at three different speeds and used three braking methods to rapidly decelerate the wheelchair to a stop. Motion of the human test pilot and HTD were recorded and described in mathematical



The Hybrid III Test Dummy

terms to enable comparisons.

Results. The calculations for the stiffness and joint/tissue friction of the hips and trunk were not statistically different. This is promising evidence that the HTD will provide realistic results in test situations where a person with a disability cannot be used because of certain risk of injury.

Relevance to Wheelchair

Users. A test device with comparable characteristics will enhance understanding of how the user, wheelchair, and environment interact, and may lead to greater mobility and less risk of injury.

-Michael J. Dvorznak, M.S.

Median & Ulnar Nerve Function Related to Wrist Range of Motion During Wheelchair Propulsion

Brad Impink B.S.E., Michael Boninger, M.D., Rory Cooper, PhD., Alicia Koontz, PhD.

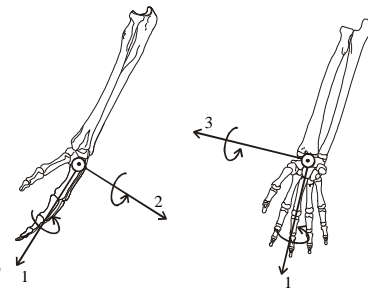
Purpose of the Work. Manual wheelchair users are commonly diagnosed with carpal tunnel syndrome (CTS) as well as ulnar nerve injury. The objective of this study was to determine if nerve function was related to wrist range of motion (ROM).

Subjects/Procedures. Thirty-five individuals with a spinal cord injury below the fourth thoracic level participated. The average age was 38.9 years and the average years since spinal cord injury was 12.25 years. Subjects were asked to propel their wheelchair at two speeds while their propulsion kinematics were recorded. The kinematic data were analyzed to determine the wrist ROM. Subjects also underwent bilateral nerve conduction studies as a measure of nerve health.

Results. Subjects using a greater ROM showed better nerve function than those subjects propelling with a smaller ROM. One possible reason for increased

nerve health in subjects with a higher ROM is they likely used a longer, smoother stroke to propel their wheelchair.

Relevance to Wheelchair Users. It is important for wheelchair users to understand causes of injuries due to wheelchair propulsion techniques. Propelling with a longer, smoother stroke may decrease damage to nerves and symptoms of CTS.



As subjects propelled their wheelchairs, the data collected was used to develop a local coordinate system for the wrist.

-Brad Impink, B.S.E.

RECENT HERL PUBLICATIONS

Corfman TA, Cooper RA, Boninger ML, Koontz AM, Fitzgerald SG, Range of Motion and Stroke Frequency Differences Between Manual Wheelchair Propulsion and Pushrim Activated Power Assisted Wheelchair Propulsion, **Journal of Spinal Cord Medicine**, Vol. 26, No. 2, Summer 2003.

de Groot S, Veeger HEJ, Hollander AP, van der Woude LHV, Short-Term Adaptations in Co-Ordination During the Initial Phase of Learning Manual Wheelchair Propulsion, **Journal of Electromyography and Kinesiology**, Vol. 13, No. 3, pp. 217-228, 2003.

Cooper RA, Boninger ML, Brienza DM, van Roosmalen L, Koontz AM, LoPresti E, Spaeth DM, Bertocci GE, Guo S, Buning ME, Schmeler M, Geyer MJ, Fitzgerald SG, Ding D, Pittsburgh Wheelchair and Seating Biomechanics Research Program, **Journal of the Society of Biomechanisms**, Vol. 27, No. 3, pp. 144-157, 2003.

DiGiovine CP, Cooper RA, Fitzgerald SG, Boninger ML, Wolf EJ, Guo S, Whole-Body Vibration During Manual Wheelchair Propulsion with Selected Seat Cushions and Back Supports, **IEEE Transactions on Neural Systems and Rehabilitation Engineering**, Vol. 11, No. 3, pp. 311-322, September 2003.

Helkowski WM, Ditunno JF, Boninger ML, Autonomic Dysreflexia: Incidence in Persons With Neurologically Complete and Incomplete Tetraplegia, **Journal of Spinal Cord Medicine**, Vol. 26, No. 3, pp. 244-247, Fall 2003.

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HERL IN THE MEDIA



Interlocking Concrete Pavement Magazine, May 2003, Pages 16-19: A Smooth Pedestrian Path

Las Vegas Review Journal, June 16, 2003: Engineer Works to Create Better Wheelchairs

New Mobility, June 2003, Page 12: Thornburghs Establish Disability Lectureship

RR&D Update, June/July 2003: Rory Cooper Receives Magnuson Award

VA Research Currents, July 2003, Page 4: Cooper Receives Magnuson Award

Veterans First, Issue 4, 2003, Page 4: VA Center Works to Improve Veterans' Quality of Life

Dateline NBC, August 10, 2003: A Whole New Set of Wheels

National Public Radio, August 14, 2003: FDA Approves 'SUV' of Wheelchairs (interview with Rory Cooper)

WTAE, 5pm news, August 18, 2003: FDA Approves IBOT

Pittsburgh Business Times, August 1-7, 2003, Page 33: Awards/Honors: Rory Cooper

The Pittsburgh Channel.com, August 18, 2003: New Wheelchair Developed with Pitt Research

New York Times, August 20, 2003, Page D-7: Users Discover Pros and Cons in Stair-Climbing Wheelchairs

Pitt Chronicle, August 21, 2003, Page 2: Cooper Wins Highest VA Research Award

University Times, August 28, 2003, Page 20: Wheelchair Enables Users to Operate on Two Wheels

Pitt Chronicle, September 8, 2003, Page 11: Pitt in the News: Rory Cooper

University Update, September 9, 2003, Page 6: Awards: Rory Cooper

FACULTY PROFILE: Donald M. Spaeth, Ph.D., ATP

Dr. Donald M. Spaeth earned a B.A. in Industrial Arts from San Diego University in 1969 and a teaching certificate in 1971 from United States International University in Point Loma, California. He went on to receive a M.A. in Rehabilitation Technology from San Francisco State University in 1982 and a Ph.D. in Rehabilitation Science and Technology from the University of Pittsburgh in 2002. Dr. Spaeth also has Assistive Technology Practitioner (ATP) certification from the Rehabilitation Engineering Society of North America (RESNA).



Donald M. Spaeth, Ph.D., ATP

For his doctoral dissertation project, Dr. Spaeth designed, built and evaluated a new type of isometric joystick that would make electric powered wheelchairs easier to drive. People who have problems controlling hand movement may have difficulty using a traditional power wheelchair joystick, which can wobble and cause the chair to crash. For many years, HERL had been developing a new type of joystick, which has a rigid, stationary handle. Instead of moving the shaft, the user presses firmly against the handle. The harder they push, the faster the chair will go. Dr. Spaeth made several design improvements to HERL's joystick and built 10 prototypes. He conducted a research study comparing people's power wheelchair driv-

ing accuracy using his newly designed isometric joystick and the traditional movement sensing joystick.

In October of 2002, Dr. Spaeth became an Adjunct Assistant Professor in the Department of Rehabilitation Science and Technology at the University of Pittsburgh and joined HERL as a faculty member. Dr. Spaeth was appointed to the position of Associate Director of Engineering at HERL in January 2003.

Dr. Spaeth received Department of Veterans Affairs Pre-Doctoral Fellowship and Associate Investigator Awards in 1999 and 2003, respectively. In August of 2003, Dr. Spaeth and HERL director Dr. Rory Cooper received a Department of Veterans Affairs Merit Review Grant to create two isometric joystick algorithms to specifically assist people with Multiple Sclerosis. Dr. Spaeth is also a task leader on a joystick project within Pitt's NIDRR Model Center for Traumatic Brain Injury (TBI) grant.

In August of 2003, the Department of Veterans Affairs applied for a patent for the isometric joystick. Dr. Spaeth is a named inventor on the patent application along with Dr. Rory Cooper and Dr. Songfeng Guo.

-Christine Heiner

CURRENT EVENTS

8th Annual Mono Ski Camp, January 12, 2004 - Jan 16, 2004

This four-day camp (with an optional 5th day) is for intermediate or advanced level mono-skiers and provides small group instruction in carving, racing and moguls. Instructors include former members of the U.S. Disabled Ski Team, PSIA examiners and a former World Freestyle Champion. For more information, please call (970) 923-0578, TTY: (970) 923-0578 or send a fax to: (970) 923-7338, send an e-mail to, possibilities@challengeaspen.com, or visit <http://www.challengeaspen.com/index2.asp>

If you know of a current event or have an ad 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

Scholarships for Students with Disabilities: As a result of an endowment fund established by the late Rick Dudley, a Maryland advocate with a disability, the Salisbury (Maryland) University Foundation has established a scholarship for graduate students with disabilities to attend this Eastern Shore school. For information about other scholarships for students with disabilities, visit the HEATH website at www.heath.gwu.edu.

Free Computers for People with Disabilities: The Jim Mullen Foundation provides free computers for people with disabilities. The organization specializes in providing computers for anybody especially for those individuals who think that they are unable to use one. For more information go to: <http://www.jimmullen.com/ZoomSeq.asp?id=7948>

FEATURED STAFF MEMBER: John Duncan

John Duncan, a native of Clarksburg, West Virginia, joined HERL as our Technical Assistant in October 2000. John carries out wheelchair testing, evaluating the mechanical, electrical, and stability properties of each wheelchair. He conducts a series of tests to assess the functional limits and safety of wheelchairs in everyday activities, such as prolonged driving and dropping off street curbs. He also tests their overall structural durability as well as how well chairs hold up in extreme environmental conditions. John helps to maintain HERL's machine shop and testing areas by ordering materials, organizing items, and servicing equipment. He also assists with research and designs projects throughout the lab.

John served in the U.S. Army and earned a B.S.



John Duncan, HERL Technical Assistant

degree in Engineering Technology from Salem-Teikyo University in Salem, WV. He has worked in construction, carpentry, and as a substitute elementary school teacher. John has a son and daughter, Daniel and Donielle, ages 19 and 20.

John enjoys working on hands-on projects in his spare time, such as working on cars and motorcycles. He has helped many people at HERL

by providing car repair and car advice. John also likes many outdoor activities such as camping and fishing, and travels to West Virginia almost every weekend to experience the outdoors. John has organized many HERL camping expeditions at his campground in the mountains of West Virginia.

-Christine Heiner

HERL at the 2003 National Veterans Wheelchair Games

For the past 4 years, HERL has organized a team of students and faculty to participate in the annual National Veterans Wheelchair Games. Our presence at the games helps us to interact with and serve our veterans who use wheelchairs. The event also gives us the opportunity to disseminate the results of our research, educate wheelchair users on the work we do, and recruit people who use wheelchairs and who live outside of Pittsburgh to participate in our research studies.

This year's games took place in Long Beach, California. HERL sent a research team of 9 faculty and students to the event. This year, we continued research on two ongoing HERL studies: the data-



The HERL Research Team at the 2003 National Veterans Wheelchair Games: (L to R) Dr. Shirley Fitzgerald, Rosi Cooper, April Hoover, Erik Wolf, Dr. Rory Cooper, Andy Kwarciak, Anmarie Kelleher, Dr. Brad Dicianno, and Dr. Dan Ding

logger study, in which we monitor how far, fast, and often people use wheelchairs, and the maintenance study, in which we collect data on how often peoples' wheelchairs need repairs. We also began 2 new studies: the lifestyles study, where we collected data on wheelchair user's dietary and exercise habits, and a weight and wheelchair propulsion study.

The wheelchair games is also an opportunity for HERL director and long-time wheelchair athlete Dr. Rory Cooper to compete in the events. This year, Dr. Cooper received two gold medals in the 100m wheelchair race and the 50m breaststroke competition. He also brought home 3 silver medals in the 50m freestyle, 50m backstroke, and Slalom competitions.

-Christine Heiner



Dr. Rory Cooper won a gold medal in the 100 meter wheelchair race



AGENCY SPOTLIGHT: Easter Seals

Easter Seals was created by a man named Edgar Allen in 1907 when his son Homer was killed in a streetcar accident.

They boy was taken to a hospital in Elyria, Ohio. The doctors told Allen that if the hospital would have had emergency medical care, they could have saved his son's life. Allen lead a campaign to raise funds and build Elyria Memorial Hospital. He was surprised through experiences at the hospital that kids with disabilities were kept out of the public and were in need of a facility to meet their medical, emotional, spiritual, social and academic needs. In 1919 Allen founded what became known as the National Society for Crippled Children, the first organization of its kind. In the spring of 1934, during the first fund drive, donors would put the seals on their envelopes and letters in a show of support. Cleveland Plain Dealer cartoonist J.H. Donahey designed the first seal.

Donahey based the design on a concept of simplicity because those served by the charity asked "simply for the right to live a normal life." Today, Easter Seals helps over a million kids and adults with disabilities and their families through a network of around 450 service sites all across the country. The organization provides medical rehabilitation, job training and employment, child care, camping and recreation, and adult day services for people with any kind of physical or mental disability. At



HERL students Erik Wolf, Andy Kwarciak, David Algood, and Tom Corfman participated in Easter Seals of Western PA's Golf Outing in August

the core of the Easter Seals organization is a common passion for caring, shared by its 13,000 staff members and thousands of volunteers, and by those who support its mission.

The Pittsburgh region is served by the Easter Seals of Western Pennsylvania chapter. This chapter provides rehabilitation, education, disability awareness, and employment services and has divisions in Pittsburgh, Johnstown, North Versailles, Franklin, Punxsutawney, Somerset, and Uniontown. In 2002, Easter Seals of Western PA invited HERL director Dr. Rory Cooper and HERL Study Coordinator Rosemarie Cooper to be the honorary chairs of their annual Cotillion. In June of 2003, our Research Coordinator Paula Stankovic lead "The HERL Panthers" team in participating in "Walk with Me" to help raise funds for Easter Seals. HERL recently sponsored a team to participate in Eastern Seals of Western PA's Golf Outing at the Diamond Run Golf Club on August 11.

You can learn more about Easter Seals and volunteer for their events at their website, www.easter-seals.org. You may also contact them toll free at 800-221-6827. You can reach Easter Seals of Western PA toll-free at 1-800-587-3257.

-Eric Wood and Christine Heiner

FEATURED HERL STUDENT: Jonathan Pearlman

Jon Pearlman, a new doctoral student in the Department of Rehabilitation Science and Technology, started working at the Human Engineering Research Labs this fall. Jon came to us from Cornell University, where he earned a MSc in Mechanical Engineering. He also holds a BS in Mechanical Engineering from the University of California at Berkeley.

Jon came to HERL already having some experience in assistive technology design. In 2002, he worked at a rehabilitation clinic in Mexico designing and building special seating devices. In 1995, he worked as an Engineering Consultant and helped to design an off-road bicycle trailer for people with disabilities. He also won first place in the 1993 American Society of Engineering Educators Freshman



Jon Pearlman

Design Contest for designing a manual bottle/jar opener for people who lack arm strength and dexterity.

Jon's primary research project at HERL is to test K10 power wheelchairs against ANSI/RESNA standards. A K10 wheelchair is a low-cost depot power wheelchair. Jon is interested in developing and designing assistive technology devices for developing nations, and hopes to focus on this research during his PhD

studies and in his future career.

In 1993, Jon received a graduate fellowship from the National Science Foundation to support his doctoral studies.

When Jon is not working or studying, he enjoys fixing up old cars, traveling, sailing, and sports.

-Christine Heiner

Human Engineering Research Laboratories

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VA Center Of Excellence For Wheelchairs
And Related Technology
University of Pittsburgh Model Center on
Spinal Cord Injury

Rory A. Cooper, Ph.D.
Director

Michael L. Boninger, M.D.
Medical Director

Shirley G. Fitzgerald, Ph.D.
Associate Director of Research,

Donald M. Spaeth, Ph.D., ATP
Associate Director of Engineering

Interested in Participating in a HERL Research Study?

Research studies at our laboratories involve participants 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 Highland Drive VA Medical Center in Pittsburgh, PA. However, some of our studies are survey based and do not involve travel.

If you're interested in participating in a HERL Research Study, contact our clinical coordinators Rosemarie Cooper or Annmarie Kelleher at (412) 365-4850.

If you are interested in obtaining further information about how you can participate in current or future studies, please contact Annmarie or Rosi, Clinical Coordinators for the Human Engineering Research Laboratories at (412) 365-4850. We look forward to hearing from you.

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