

Institute Insider

The Newsletter of the Institute for Ergonomics at The Ohio State University

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Members of Biodynamics Laboratory Win IEA/Liberty Mutual Prize

The Liberty Mutual Research Institute for Safety and the International Ergonomics Association (IEA) recently announced the winner of the 2003 Liberty Mutual Prize. It was presented to Dr. William S. Marras, Dr. Sue A. Ferguson, Dr. Deborah Burr, Dr. Kermit G. Davis, and Dr. Purnendu Gupta, in recognition of their scientific paper entitled, *Kinematic Compromise Predicts Spine Loading in Low Back Pain Patients During Lifting*. This award was received in August, 2003, at the IEA XVth Triennial Congress in Seoul, Korea.



Dr. Marras is the Director of the OSU Biodynamics Laboratory and Co-Director of the Institute for Ergonomics. Dr. Ferguson is a Senior Research Associate Engineer with the Biodynamics Lab. Dr. Burr is on faculty of the OSU School of Public Health. Dr. Davis teaches in the Department of Environmental Health at the University of Cincinnati. Dr. Gupta specializes in orthopaedic surgery at the University of Chicago.

The paper addresses the potential causal mechanisms for recurrent or secondary low back pain (LBP). In the study, sponsored through a four-year grant by the Ohio Bureau of Workers' Compensation, researchers examined biomechanical trends and interactions involved with loading the spine. The test participants, 62 LBP patients and 61 asymptomatic individuals, performed lifting exertions varied in origin, asymmetry position, and weight. Researchers used an EMG-assisted model to evaluate the subject's spine loading, and statistical models assessed the relationship between kinematic compromise and spine loading. The study reveals that the LBP participants experience greater spine loading than asymptomatic individuals performing the same task.

Another notable finding suggests that a simple kinematic "clinical-test" can accurately predict spine loading for employees returning to work following a LBP injury.

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"Hindsight Bias" a Possible Outcome of Space Shuttle Accident Report

A psychological effect known as "hindsight bias" could cause people to misinterpret the conclusions of the Columbia Accident Investigation Board (CAIB), according to Dr. David Woods, professor with the Institute for Ergonomics and co-director of the Cognitive Systems Engineering Lab. Dr. Woods provided technical input on decision making, organizational factors, and hindsight bias to the CAIB during its investigation, which is referenced in Chapter 7 of the report.



One example of the dangers of the hindsight bias is this question, "Why did NASA continue flying the Shuttle with a known problem?" The "known problem" refers to the dangers of debris striking and damaging the Shuttle wing during takeoff which the board has identified as the physical cause of the accident.

"As soon as the question is posed in this way, readers risk being trapped into oversimplifying the situation and uncertainties people faced before the outcome is known," Woods said. After the fact, the past seems incredible, and the organization looks irrational or negligent to obvious risks. However, before any accident, people may see potential warning flags but not follow through aggressively, since that potential future looks implausible.

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Biodynamics Lab Research Assists to Drastically Reduce Company's Workers' Compensation Payments

The Ohio Bureau of Workers' Compensation awarded the Deluxe Business Services company its 2003 Governor's Excellence in Workers' Compensation Award.

In the past five years, Deluxe's facility in Streetsboro, Ohio reduced their workers' compensation costs by 98.8%. This was due to



(L to R) Jim Samuels, Mike Kinsella, James Conrad, Kevin Buck

Deluxe's return-to-work program, employee involvement, and safety training initiatives.

Deluxe also recognized efforts on the part of OSU Biodynamics Lab members as a contributor to this reduction. **Dr. Sue Ferguson**, Senior Research Associate Engineer at OSU, led data collection efforts at Deluxe and used the Lumbar Motion Monitor to evaluate the work demands of employees who suffered low back strains while performing jobs at this facility. Results from this analysis were used by Deluxe to improve employee working conditions. This multi-year research project was funded by the Ohio BWC.

Deluxe was the only company, among 1,100 self-insured Ohio employers, to win this award. It was presented by James Conrad, CEO/Administrator for the Ohio BWC and Jim Samuels, Governor Bob Taft's Executive Assistant for Business & Industry, to Kevin Buck (Plant Operations Manager) and Mike Kinsella (Environmental, Safety, Security and Health Specialist) of Deluxe. Dr. Ferguson also attended the ceremony and was recognized for her contributions to this effort.



Deluxe employee wearing the Lumbar Motion Monitor

On the Move



In April 2003, **David Woods** was interviewed for the documentary segment "Airplane Incidents," which included a story about a near miss event (China Airlines, Flight 6). Dr. Woods discussed the factors that contributed to this and related events, in particular the interactions between pilots, flight computers, and the autopilot.

This segment ran on Japan's Fuji Television Network's television program, "Unbelievable," a weekly, primetime documentary-style series featuring stories from around the world that focus on human interest, science, and nature topics geared towards a family audience.

The TV producers also filmed in the laboratory of **Nadine Sarter** and included a desktop simulation of flight controls and displays that have been used for studies of how to improve the coordination between flight crew and cockpit automation. PhD-candidate **Mark Nikolic** demonstrated some of the capabilities related to his work with Professor Sarter.



William Marras, Sue Ferguson, Deborah Burr, and Purnendu Gupta were awarded the 2003 Best Poster Award at the annual meeting of the International Society for the Study of the Lumbar Spine in Vancouver, Canada (May, 2003), for their poster *Functional Impairment and the Prediction of Spine Loading*.



David Woods gave the keynote address, *Norbert's Contrast: Literal Minded Machines, Context Bound People, and Cognitive Work*, at the IBM Human Interaction with Autonomic Systems Conference in San Jose, California (June 18th, 2003).



James Sheedy, Associate Professor of Optometry and Vision Science, has received \$180,000 from the Microsoft to support two areas of his research program.

One area of research is studying the effects of font type and pixel arrangements upon legibility and readability. Dr. Sheedy also will study the question, "What is eyestrain?" His earlier research has already determined that all eyestrain is not the same, in that the perceived sensations and location of the eyestrain are dependent upon the stimulus that caused it. Other findings suggest that eyelid squint and blinking are inter-related and responsible for some forms of eyestrain.

Dr. Sheedy intends to identify the mechanisms of eyestrain, perhaps providing a physical measure that can be used for better clinical management of eyestrain.



Gary Allread spoke about "Reducing Costs Using an Effective Ergonomics Process" to the Central Indiana chapter of the American Society of Safety Engineers in Indianapolis, Indiana (July 16th, 2003).



David Woods has received an educational grant from the Dept. of Education for, "Training Industrial Engineers to Manage High-Risk, Complex Systems: Applying Cognitive Engineering to Human Factors and Automation in the Oil Industry." Training partners include Stephanie Guerlain (U. of Virginia) and Brazilians Jose Orlando Gomes, Wattson Perales, and Dierci Marcio Silveira.



Nadine Sarter is beginning a new research project, "The Design of a User-Centered Interface for Supporting Fault Management in Future Intelligent Propulsion Systems." This project is being funded by NASA Glenn and carried out in collaboration with General Electric.



For the past year, **David Woods** has been a member of the Committee on Aerospace Research and Technology for Vision 2050 (Aeronautics and Space Engineering Board, Transportation Research Board, National Research Council). The final report from this committee's work will be released on September 19th.



William Marras gave a Plenary Address at the XVth Triennial Congress of the International Ergonomics Association in Seoul, Korea (August 24th-29th, 2003). His address discussed *The Future of Research in Understanding and Controlling Work-Related Low Back Disorders*.



Cathy Heaney, Associate Professor in the OSU School of Public Health, will be visiting Stanford University during the 2003-04 academic year. While at Stanford, Dr. Heaney will be working in the Human Biology Department, introducing a course in health behavior change and teaching a course on stress and health. Her research there will be based at the Stanford Prevention Research Center, which has a long history of conducting cutting-edge research in community health intervention. She also hopes to forge some interdisciplinary collaborations in the area of occupational health and safety intervention effectiveness. In addition, she will be working with occupational researchers at UC-San Francisco and UC-Berkeley. During her sabbatical, Cathy can still be reached at cheaney@sph.osu.edu.



Philip Smith has been elected to Fellow status of the Human Factors and Ergonomics Society. This is one of the highest honors that the Society bestows upon its members. Dr. Smith will be formally recognized with this honor at the Opening Plenary Session of 2003 HFES Annual Meeting on October 14th, 2003, in Denver, Colorado.



Graduate Student News

New Student Chapter Forms

A new OSU student organization has begun, specifically for students interested in ergonomics. Upcoming activities include an introductory meeting and two speaker meetings. Once the group grows to 15 members it will apply for affiliation with the national Human Factors and Ergonomics Society.

Student chapters provide services to members and act as a vehicle for getting students involved with HFES at the national level. This chapter will provide students with opportunities to:

- Meet students from different academic disciplines having a common interest in human factors/ergonomics;
- Meet faculty and learn about a diverse range of research opportunities;
- Listen to speakers who work in human factors and ergonomics, from industry and other universities; and
- Visit companies and labs that do work related to human factors and ergonomics.

Meetings will be held in 210E Baker Systems (1971 Neil Ave.), beginning at 5 PM. Upcoming events are:

• **October 2nd**: Kick-off meeting and introductions by faculty and students.

• **October 23rd**: Dr. Richard Jagacinski, professor in the OSU Cognitive Psychology Department and author of *Control Theory for Humans: Quantitative Approaches to Modeling Performance*.

• **November 13th**: Dr. Kermit Davis, professor with the Environmental & Industrial Hygiene Department, University of Cincinnati, and former OSU graduate student, will be discussing his latest research.

Local members of HFES and the Institute are invited to attend these meetings, serve as meeting speakers, and offer their work facilities as potential tour sites for this student group. For further information, contact the group's faculty sponsor, Dr. Carolyn Sommerich (sommerich.1@osu.edu; 614-292-9965).

Listserves. A moderated listserv has been created for this new chapter, to provide reminders of meetings and other relevant information.

To subscribe, send the following email message:

To: listserv@lists.acs.ohio-state.edu
subscribe hfergo YourFirstname YourLastname

To post a message, send an email in the form:

To: hfergo@lists.acs.ohio-state.edu
Subject: My first post
[message text]

New Students

Please welcome these students who have recently begun graduate studies in ergonomics.

Jake Banks

(banks.221@osu.edu)

Advisor: Dr. Steven Lavender

Hometown: Cadillac, MI



Jeff Hoyle

(hoyle.12@osu.edu)

Interests: Ergonomics and biomechanics

Advisor: Dr. William Marras

Hometown: Denver, NC



Dale Rhoda

(rhoda.4@osu.edu)

Advisor: Dr. Philip Smith

Interests: Developing automated decision support tools

Hometown: East Millinocket, ME



Josh Schoenwald

(schoenwald.2@osu.edu)

Advisor: Dr. David Woods

Interests: Human error analysis, designing interactions and interfaces

Hometown: Cypress, CA



Stoney Trent

(stoneytrent2@yahoo.com)

Advisor: Dr. David Woods

Interests: Military command and control

Hometown: Yukon, OK



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Student Research

Masters Thesis: **Swetha Sivakumar**

Advisor: Dr. William S. Marras

Title: *Effect of Various Lifting Frequencies Throughout the Workday on the Spine Loads of Novice Workers*



Objective: To examine the effect of various lifting frequencies on the spinal loads of novice workers monitored throughout a workday. To understand how the lift frequency interacts with load weight to influence biomechanical changes in the body.

Background: Previous efforts to control risk associated with lift frequency have been based upon subjective (psychophysical) acceptance of risk (not necessarily to the back) usually over a short period of lifting or whole body oxygen consumption and heart rate limits (physiologic studies). Repetitive lifting studies in the past have not studied the changes in trunk kinematics as well as muscle coactivation pattern, which occurs as a function of change in frequency and duration of exertion.

Methods: Twelve inexperienced students were recruited. The experimental design involved a biomechanical study of spine loading while lifting at various frequencies and weights for a period of eight hours or the endurance time, whichever came first. The task simulates a production task that might be encountered in a manufacturing type environment. An electromyographic (EMG) assisted model was used to evaluate 3-D spine loads (Compression, A/P Shear and Lateral Shear). The subjects lifted boxes (of weight 1.1 kg, 4.9 kg or 11.7 kg) at a certain frequency (2, 4, 6, 8, 10 or 12 lifts per minute) for a given day.

Results: The effect of frequency on changes in compression over the period of lifting was found significant. Lift frequencies were found to have “U” shaped response with changes in compression. Exposures to low (2, 4) and high frequencies (10, 12) caused a greater increase in compression than the moderate frequencies (6, 8). With increasing weights, an increase in compression values approaching and exceeding the tolerance limits are noted.

Conclusions: Lift frequencies have a non-monotonic relationship with change in compression throughout the workday. There is a tradeoff between muscle grooving patterns and development of muscle fatigue affecting this relationship. For this specific experimental task, the moderate frequencies (6,8) strikes a good balance between constant loading, with little dynamicity, occurring at low frequencies (2,4) versus overexertion and extreme fatigue occurring at the high frequencies (10,12). Increasing weights with respect to frequency causes an increase in the net compression throughout the day.

Swetha can be reached at swetha_sk@yahoo.com.

Doctoral Dissertation: **Delia Treaster**

Advisor: Dr. William S. Marras

Title: *An Investigation of Postural and Visual Stressors and their Interactions during Computer Work*



The continuing dominance of computers and the rising chorus of complaints from computer users highlight the importance of understanding the risks associated with computer use. Particularly challenging are the issues of eyestrain and muscle pain, the latter particularly puzzling because of the low force levels and static postures of computer work. To study eyestrain and muscle pain during computer work, a multi-disciplinary approach was developed, using techniques from three diverse fields: biomechanics, myofascial pain and vision.

A laboratory study was used to examine the effects of the independent variables, postural and visual stress, during a 30-minute typing task. Sixteen healthy females (ages 19-29) participated in the experiment; all were touch-typists. The study design was a 2 x 2 repeated measures, with randomized order of testing. The dependent variables included development of trigger points in the upper trapezius, subjective measures of discomfort, visual function, and surface electromyography (EMG). Trapezius EMG data were collected at locations of known trigger points. This provided information about EMG as the trigger points developed during the experiment. An experienced myofascial specialist performed onsite examination to identify the trigger points before and after each experimental session. Cyclical changes in the EMG median frequency that occurred throughout the experiment were quantified. These cyclic changes provided information regarding motor unit rotation patterns. A method for quantifying eyestrain through EMG changes in the obicularis oculi was also developed.

There was a significant interaction between postural and visual factors on both the perception of eyestrain and on the trapezius EMG. In particular, the high visual stress condition, when combined with the low postural stress condition, produced fewer cyclic changes in median frequency (i.e. less motor unit rotation), and greater trigger point pain.

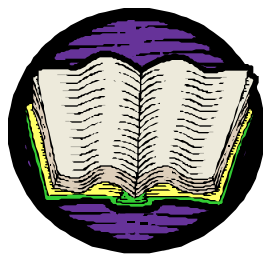
A hypothesized injury pathway for the development of myofascial trigger points was developed. The role of high visual stress, perhaps mediated through the stress reaction of the autonomic nervous system, was also postulated. The importance of good ergonomics in terms of location of computer components as well as visual parameters is highlighted. The findings of the interactions show the value of a multi-disciplinary approach to a complex problem.

Delia can be reached at treaster.3@osu.edu.

PUBLISH

or perish

The recent publications written by Institute members include:



The Case for Cumulative Trauma in Low Back Disorders. 2003. W.S. Marras. *The Spine Journal*, 3(3): 177-179.



Discovering How Distributed Cognitive Systems Work. 2003. D.D. Woods. In E. Hollnagel, ed., *Handbook of Cognitive Task Design*, Lawrence Earlbaum Associates, Inc.



Effect of Torso Flexion on the Lumbar Torso Extensor Muscle Sagittal Plane Moment Arms. 2003. M.J. Jorgensen, W.S. Marras, P. Gupta, and T.R. Waters. *The Spine Journal*, 3(5): 363-369.



Partitioning the Contributing Role of Biomechanical, Psychosocial, and Individual Risk Factors in the Development of Spine Loads. 2003. K.G. Davis and W.S. Marras. *The Spine Journal*, 3(5): 331-338.



New Students

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David Trippany

(dtrippany@hotmail.com)

Advisor: Dr. William Marras

Hometown: Findlay, OH



Sahika Vatan

(vatan.1@osu.edu)

Advisor: Dr. Carolyn Sommerich

Hometown: Ankara, Turkey



Martin Voshell

(voshell.2@osu.edu)

Advisor: Dr. David Woods

Hometown: Holden, MA



Recent Patient Safety Research

Roger Chapman is currently working on two research projects aimed at improving patient safety.



Improved Medication Administration Software

This design project aims to provide Veterans Administration Medical Center (VAMC) nurses with better situation awareness during the administration of medications. Nurses use a software system, called Bar Code Medication Administration (BCMA) because both the patients and their medications are bar coded with wristbands and labels respectively. However, this software lacks an overview to allow the nurses to see the medications that are about to be given in a broader context.

Research Corner

Dr. Chapman worked with a group of nurses, pharmacists, and software developers to design an interface that allows dangers to patient safety to be seen at a glance.

Examples include medications that were missed during the previous nurse's med pass, a future view to enable the medications due to expire to be seen at a glance, and information that needs to be easily integrated without going through multiple screens, such as special instructions involving vital sign parameters and the current value of those parameters for this patient.

The design was presented to the BCMA development group, and now a new service request is being constructed to have the design implemented.

Evaluation of a PDA version of BCMA

Dr. Chapman used usability inspection, usability testing, and structured interviews to identify safety and efficiency issues in the design of a PDA version of BCMA. This identified hidden critical data, memory demand problems, navigation efficiency problems, problems from a too literal translation from a desktop-based application, diversity in the use of the system in different settings, and the use of paper-based overviews in order to supplement the limited view available through the small display. This led to the developers implementing all the high priority recommendations that were communicated to them in order to improve the usability of the system.

Upcoming Conference Information

Institute Co-Sponsors Conference

The Institute for Ergonomics is pleased to be an academic co-sponsor for the 7th Annual Applied Ergonomics conference. As the core assembly of the ergonomics community, this conference is the leading forum for presenting ergonomics applications.

The AEC will be held March 8th - 11th, 2004, at the Rosen Centre Hotel in Orlando, Florida. More information is available at the conference's web site, www.appliedergo.org.



2004 AIHce Call for Presentation

The American Industrial Hygiene Association's annual conference will be held May 8th - 13th, 2004, in Atlanta, Georgia. The deadline for submitting presentations is October 7th, 2003. For details, visit www.aiha.org/abstract.html.

AIHA promotes, protects, and enhances industrial hygienists and other occupational health, safety and environmental professionals in their efforts to improve the health and well being of workers, the community, and the environment.



Prize

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"The findings are a step toward controlling secondary low back disorders for those who experience a low back pain event," explains Dr. Marras. "A simple comparison of trunk kinematic status to work requirements could identify situations that place a worker at a greater risk for a costly low back re-injury. With this knowledge, we can more scientifically design the workplace to minimize risk for the returning worker." He continues, "I'm delighted that Liberty Mutual and IEA recognize the importance of our research."

The Liberty Mutual Prize, with a cash award of \$5,000, recognizes outstanding, original research in the field of occupational safety and health. An IEA appointed committee judges how well entries explain ways to either avoid or mitigate occupational accidents or to promote rehabilitation and return-to-work. The Liberty Mutual Research Institute for Safety, owned and operated by the Liberty Mutual Group, is an occupational safety and ergonomics research facility located in Hopkinton, Massachusetts. Recognized throughout the world, the Research Institute continually contributes to the reduction of workplace injury and illness and work-related disability through peer-reviewed publication of research findings.

"Hindsight Bias"

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It is difficult it is for readers to disregard "20/20 hindsight", so they can misinterpret the report and play the classic blame game, seeing a "bad" organization as the culprit.

Readers of the report need to escape hindsight and see how the accident's lessons apply to all organizations that have to balance safety risks with pressure for efficiency. "Once outcome shows all the real risks, it is extraordinarily difficult to see the conditions that led people to miss what now seems obvious to all," said Dr. Woods. Thus, readers can miss how difficult it can be to slow down today's real production goals to consider possible future risks.

Helping organizations maintain high safety despite production pressure is the topic of a newly emerging area of research known as Resilience Engineering. Woods states, "We can't change the past, despite the tragedy. But the future is open to us: will the next accident report, again, describe how safety defenses eroded over time in the face of production pressure? If we recognize the CAIB's analysis applies to all organizations, not just NASA, we can learn how to balance acute pressures for efficiency with chronic need for high safety so that this pattern doesn't recur."