

Institute for Ergonomics



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

At the forefront of Human Factors since 1950 Vol. 3, No. 3, Autumn 2000

INSTITUTE MEMBERS WIN AWARD FOR OUTSTANDING JOURNAL ARTICLE

The Jerome H. Ely Human Factors Article Award was given to Stephanie Guerlain, Philip Smith, Jodi Heintz Obradovich, Sally Rudman, Patricia Strohm, Jack Smith, John Svirebely, and Larry Sachs, for their paper titled, *Interactive Critiquing as a Form of Decision Support: An Empirical Evaluation*. It has been published in **Human Factors** (Vol. 41, Number 1).

The award was given out at the Congress Banquet and HFES Awards Ceremony, in San Diego, at this year's IEA/HFES conference.

This paper was recognized for its unique application to a significant human factors problem in medical systems. A new and outstanding use of artificial intelligence technology was studied in a real decision support application, with real experts, and with objective outcome measures. The paper serves as a benchmark for the design and use of AI in human decision support systems.

Dr. Guerlain is currently at the University of Virginia and received her Ph.D. at OSU under Dr. Phil Smith. He and Ms. Heintz Obradovich are affiliated with the Institute. Dr. Strohm is with the Northside Medical Center, and the remaining co-authors work and study in the OSU College of Medicine.

Kudos on a job well done!



Stephanie Guerlain



Philip Smith

Honda's Head Ergonomist to Speak at Institute

Dr. Robert Smith, Manager of the Ergonomics Group at Honda of America, is slated to be the Institute's Autumn Quarter seminar speaker. Dr. Smith will give his talk on **Thursday, November 16th**, from 11 am until 12 noon. The topic of his presentation will be "Ergonomics Support of Manufacturing."

In this talk, Dr. Smith will

discuss the various roles and responsibilities an ergonomics program plays in a dynamic manufacturing environment.

The seminar will take place in Room 357 Dreese. It is **free** and open to the public.

Please contact the Institute for more information or for directions.



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The Technical Person of the Year award, given by the Columbus Technical Council was presented to **Stu Zweben**. (April)

Jay Wilkins was awarded a grant from the CDC/NIOSH to study the physical demands of farm jobs and the risk for musculoskeletal injury they pose to children. (August)

Stu Zweben participated in a panel at the Computing Research Association's Conference at Snowbird (Utah) on *Recent Experiences with Computer Science and Engineering Accreditation*. (July)

Gary Allread presented the talk, *Common Ergonomics Mistakes Companies Make ... And Ways to Correct Them* to the Portsmouth Safety Council and the Marion Area Safety Council. (August and September)

Alumnus **Sidney Dekker** is now a professor at Linköping Institute of Technology in Sweden. He recently published a new book, with Erik Hollnagel, titled, *Coping with Computers in the Cockpit* (Ashgate, 1999).

Institute Helps Set National Research Priorities on Patient Safety

As past HFES President, Dave Woods of the Institute, testified at the Quality Interagency Coordination Task Force (QuIC)'s first National Summit on medical errors and patient safety research, September 11th, in D.C.

Organized in conjunction with the Agency for Healthcare Research and Quality, the lead government agency for improving safety, Woods was one of a diverse group of invited panelists from the research, practice, patient, and policymaking arenas who gathered to help develop priorities for research on patient safety.

Speaking for the human factors/ergonomics community, Woods pointed out that where health care is puzzled by human behavior, there are systematic patterns and lawful relationships in problem-solving, cooperative work, human-computer interaction, and other aspects of human performance. But these patterns are difficult for health care to see because they are not



the natural laws of physiology or disease processes, but the natural laws of cognitive, social, and behavioral sciences. As a result, Woods said, "Our first recommendation is that the research program be built from the beginning as a substantive partnership between human performance specialities and health care specialities."

The specific recommendations submitted at the summit are available, as is a transcript of the oral testimony. E-mail Dave (woods.2@osu.edu) for more information. Also, a video of the summit (as a real audio file) is available on the web, at www.quic.gov/summit/summitvid.htm.

W³ Watching Human Factors Watch People at Work, the multimedia 1999 Presidential Address by Dr. David Woods, is now available on CD. Contact the Institute to obtain your copy.

Getting to Know . . . Masters Degree Students

In this issue, we have highlighted students pursuing their Masters at the Institute, in either cognitive or physical ergonomics



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RILEY SPLITTSTOESSER
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Advisor: William Marras
Home town: Urbana, Illinois



Masters Degree Students Not Pictured:

JOHN MCGUIRL
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Advisor: Nadine Sarter
Hometown: Cumberland, R.I.

ERICA ORRICK
(orrick@acm.org)
Advisor: David Woods
Hometown: Lake Jackson, Texas

NICK PAPPAS
(pappas.34@osu.edu)
Advisor: Philip Smith
Hometown: Columbus, Ohio

Graduate Student News

Delia Treaster successfully defended her Ph.D. General Exams, in July (Advisor: William Marras)

Mark McMillion graduated in June, with a Masters degree. He has since returned to the U.S. Military Academy at West Point (Advisor: David Woods)

Klaus Christofferson became a post-doctoral fellow at the Cognitive Engineering Lab at the University of Toronto (Advisor: David Woods)

Correction: **Mark Nikolic** was inadvertently omitted from the last newsletter's profile of Ph.D. students (Advisor: Nadine Sarter)

Publish or Perish

The following research articles, authored by Institute members, have recently been published.

- Allread WG, Marras WS, and Burr DL, 2000, Measuring trunk motion in industry: variability due to task factors, individual differences, and the amount of data collected, **Ergonomics**, **43**(6), 691-701.
- Davis KG and Marras WS, 2000, Assessment of the relationship between box weight and trunk kinematics: Does a reduction in box weight necessarily correspond to a decrease in spinal loading? **Human Factors**, **42**(2), 195-208.
- Ferguson SA, Marras WS, and Gupta P, Longitudinal quantitative measures of the natural course of low back pain recovery, **Spine**, **25**(15), 1950-1956.
- Nelson JE, Treaster DE, and Marras WS, 2000, Finger motion, wrist motion and tendon travel as a function of keyboard angles, **Clinical Biomechanics**, **15**, 489-498.
- Olson WA and Sarter NB, 2000, Human-machine coordination and cooperation: a study of pilot preferences for and operational experiences with automation management strategies and implementations, **International Journal of Aviation Psychology**, in press.
- Sarter NB, 2000, The need for multisensory feedback in support of effective attention allocation in highly dynamic event-driven environments: the case of cockpit automation, **Int'l Journal of Aviation Psychology**, in press.
- Sarter NB and Amalberti R, (eds.), 2000, **Cognitive Engineering in the Aviation Domain**, Hillsdale, NJ: LEA, in press.
- Sarter NB and Woods DD, 2000, Teamplay with a powerful and independent agent: a full-mission simulation study, **Human Factors**, in press.
- Treaster DE and Marras WS, 2000, An assessment of alternate keyboards using finger motion, wrist motion and tendon travel, **Clinical Biomechanics**, **15**, 499-503.

Ergo Briefs

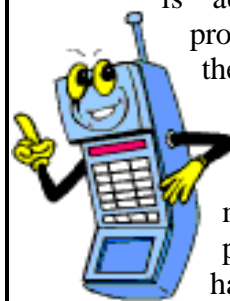
Less Monotony in Denmark

Danish officials have claimed that an action plan implemented in 1993 to address monotonous work has been successful. The Danish Technology Institute reported that, in the past 7 years, the number of employees in "monotonous, repetitive work" has been reduced by 25%. They also found that more than 90% of companies having boring, repetitive jobs took successful steps to improve them.



Reach Out and Touch Someone . . . More Easily

More mobile phones are now Internet-capable, so pushing the phones' small buttons and reading their screens is an increasing problem. Phone maker Nokia is addressing this problem through the design of a roller that works like a computer mouse. Future phones will have bigger screens, touch and voice commands, and attachable letter-based keyboards.



Research Corner

This column features some of the Institute's recent research projects.



Vibrations May Deliver Crucial Information to Pilots, Others

Nadine Sarter, Ph.D.

Researchers at Ohio State are exploring ways for pilots to monitor automated flight deck systems with their skin instead of just their eyes and ears.

A study has revealed that pilots are more likely to notice changes in the status or behavior of these systems and react faster-when these changes are announced in the form of a vibration instead of a conventional visual indicator. The same technology may foster human-machine communication in other situations.

Sarter reported in a recent *Human Factors* article that, depending on workload and flight phase, pilots detected up to 40% more signals-sometimes more than twice as rapidly- when they received vibrations from a small device worn like a wristwatch.

"We have many senses, and touch is one of the most underutilized, and a very powerful one," Sarter said. "Pilots receive a great deal of visual & audio feedback but tactile cues are rare."

Sarter's initial work in this area at the University of Illinois at Urbana-Champaign was funded by the FAA. Now the NSF funds her continued work at OSU, with the idea that her findings may be useful outside aviation as well.

"The same principle could work in an operating room, nucle-

ar power plant, or space shuttle-any highly automated place where humans must communicate with machines," she said.

Today's computerized aircraft are capable of performing many tasks independently. An on-board computer could initiate a maneuver or safety procedure when the pilot doesn't expect it. If the pilot does not notice, he or she may be surprised later when the change becomes more apparent-and possibly difficult to recover from.

"More and more, on-board computers present those changes in the form of visual feedback-words and numbers that appear on numerous displays in the cockpit," Sarter said. "So the pilot has to monitor all the instruments very carefully and combine information from many different displays to get an idea of what the automation is doing."

For her research, Sarter has been using a device called a "tactor," manufactured for people with visual or hearing impairments. Like a pager, the tactor vibrates when it receives a signal.

For this most recent study, Sarter and former graduate student Aaron Sklar tested the reactions of 21 certified flight instructors, who averaged more than 600 hours of flight experience. Pilots took turns in a flight simulator. A third were notified of changes in automation status and behavior through visual cues only. A third wore a tactor and received the information only through a vibration on their wrist. The remaining third received a vibration at the

same time as a visual cue. Pilots receiving only visual cues noticed when the computer changed status only 83% of the time. Pilots in the other two groups noticed changes nearly all of the time.

Pilots wearing tactors were also faster to respond to changes. In one case, they responded in less than half the time-about two seconds versus five seconds-than pilots who had to rely on visual cues only. For most other events, pilots wearing the tactors responded about a second sooner.

Sarter and Sklar also discovered some limitations to tactile feedback. For example, pilots sometimes didn't notice vibrations that occurred while the arm wearing the tactor was busy with some other task, such as manipulating aircraft controls. Existing vibrations on the flight deck may interfere with the perception of the tactor feedback, Sarter said.

With graduate student Mark Nikolic, Sarter has also looked at another powerful sensory channel for capturing attention-peripheral vision. In another simulator study to be published in *Human Factors*, Sarter and Nikolic have shown that this channel is not as effective as the vibrotactile cues, but still more successful than current focal visual indications of automation status and behavior.

"Ultimately, our goal is to distribute information across many channels-audio, focal visual, peripheral visual, and tactile-to support task-sharing and adapt to different task and flight contexts," Sarter said.

For more info, contact Nadine Sarter, Sarter.1@osu.edu. This article was written by Pam Frost (Frost.18@osu.edu).

Ergonomics for the New Millennium

XIVth Triennial Congress of the International Ergonomics Association and 44th Annual Meeting of the Human Factors and Ergonomics Association



The Institute was well-represented, on several fronts, at the joint IEA/HFES conference held in San Diego this past summer:

- Dave Woods, Bill Marras, and Larry Fine gave plenary talks;
- Institute members participated in over **20** additional research presentations and panel discussions. These talks are listed on page 7. Authors and presenters affiliated with Ohio State or the Institute are noted in *italics*;
- The Institute sponsored a booth in the exhibit hall, providing information to academicians and ergonomics practitioners world-wide; and
- Bill Marras organized a Biodynamics Lab "reunion" dinner, bringing together current and past graduate students.

Plenary Sessions

Complementarity and Synchronization as Strategies for Practice-Centered Research and Design - *David D. Woods*

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Occupational Low Back Disorder Causation and Control - *William S. Marras*

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The Magnitude, Science Basis, and Solutions for One of the Largest Occupational Health Problems in the United States - *Lawrence J. Fine*



Candi McCain, at the Institute booth

Steve Lavender, Gary Mirka, and Anthony Maronitis (left to right) at the Biodynamics Lab reunion dinner.



Research Papers

Validation of Low-Back Disorder Risk Model in a Prospective Study of Ergonomic Interventions in Manual Materials Handling Jobs -*WS Marras, WG Allread, DL Burr, and FA Fathallah*

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Trade-Offs between Trunk Flexion, Hip Flexion, & Knee Angle in Lifting Below Waist Level -*RE Splittstoesser, KG Davis, and WS Marras*

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The Effects of Case Features on Spine Loading and Low Back Disorder Risk during Order Selecting - *WS Marras*

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A Study of the Relationship Between Personality and Risk Factors for Musculoskeletal Disorders - *WG Allread*

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Influence of Job Stress on Muscle Activity and Spinal Loads -*KG Davis, WS Marras, CA Heaney, and AB Maronitis*

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The Effectiveness of Whole-Body and Localized Measures of Fatigue -*AB Maronitis, KM Kovacs, RE Splittstoesser, and WS Marras*

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Field Evaluation of an Intelligent Tutoring System for Teaching Problem-Solving Skills in Transfusion Medicine - *PJ Smith, JH Obradovich, SA Guerlain, S Rudmann, and JW Smith*

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Detection and Quantification of Inefficiencies in the National Airspace System - *PJ Smith, M Klopfenstein, J Jezerinac, S Augustine, R Chapman, J Obradovich, and CE McCoy*

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Quantification and Prediction of Male and Female Spine Loading Muscles - *MJ Jorgensen, WS Marras, and KP Granata*

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A Model of Communication in Support of Distributed Anomaly Response and Replanning -*RWY Chow, K Christoffersen, and DD Woods*

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A Comparison of Males and Females during Asymmetric Lifting -*KG Davis, WS Marras, and DP Young*

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State of the Art in Functional Capacity Evaluations - *SA Ferguson*

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Assessment of Anatomical Representations of the Trunk Muscles in EMG-Assisted Spinal Load Models -*WS Marras, KG Davis, and MJ Jorgensen*

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Overview of Electromyography in Ergonomics - *WS Marras*

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Predicting Low Back Functional Performance Recovery -*SA Ferguson, WS Marras, CA Heaney, and P Gupta*

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Observational Methods to Evaluate Job Stressors of the Upper Limb -*S Burt, D Wigmore, D Habes, L MacDonald, CF Estill, L Piacitelli, T Waters, S Baron, B Bernard, and LJ Fine*

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Combined Spinal Motion and Loading in Occupational Low Back Disorders - *FA Fathallah, WS Marras, and M Parnianpour*

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A Neuro-Fuzzy System for Predicting the EMG of Trunk Muscles based on Lifting Task Variables -*W Lee, W Karwowski, and WS Marras*

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A Biomechanical Assessment of Alternate Keyboards using Tendon Travel - *DE Treaster and WS Marras*

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Human-Automation Interaction in Aviation: Modeling the Information Environment - *MG Shafto*

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Panel Discussions

Designing for Medical Work Domains: Challenges, Directions, Opportunities -*JR Hajdukiewicz, MB Weinger, PM Sanderson, DD Woods, RI Cook, and J Gosbee*

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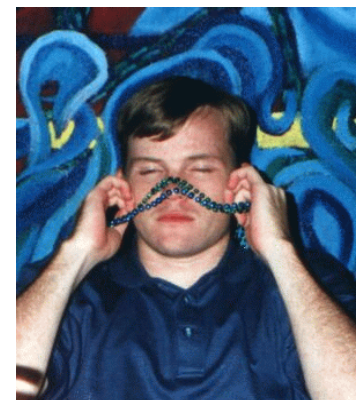
Backbelts: The Science and Reports of Effectiveness -*LJ Fine, D Cochran, J Kraus, and JJ Congleton*

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Soft Tissue Pathomechanics and its Application to Ergonomics -*RG Cutlip, WS Marras, GL Warren, DM Rempel, and WT Stauber*



Bill Marras (top) and Ben Lucas (bottom) at the Biodynamics Lab reunion dinner.



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