Institute *Insider*

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

At the forefront of Human Factors since 1950 Volume 9, No. 2, Spring/Summer, 2006

More Hotel Amenities . . . More Housekeeper Injuries?

If you are a frequent traveler, you may have noticed that hotels have provided many new items to their rooms in an attempt to increase your comfort. Leading hotel chains have introduced more-luxurious beds, often piled with additional linens and multiple pillows. Newer amenities often include bathrobes, coffee pots, ironing boards, and wet bars.

However, these features produce considerably more work for hotel housekeepers cleaning these rooms. In addition to lifting heavier mattresses during bed-making and fitting cases on more pillows, these employees vacuum, dust, wash mirrors, scrub bathroom tiles, clean hair dryers, and re-stock towels and other bathroom supplies. Dealing with these amenities can increase room-cleaning times by up to 50%.

There are an estimated 350,000 hotel housekeepers working in the U.S. Unite Here, a labor union representing hotel workers, issued a report showing that, from 1999 to 2005, housekeepers were injured at a rate of 10.4 injuries per 100 workers, which is 86% higher than the injury rate experienced by other hotel workers. Their report also included survey results from

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Biodynamics Laboratory Welcomes Clinical Director

Gabriel

Josue Gabriel, Assistant Professor of Orthopaedics at The Ohio State University and Director of its Division of Spine, has been named Clinical Director of OSU's Biodynamics Laboratory.

Dr. Gabriel earned his medical degree from the University of Pennyslvania in 1991. He performed his general surgery internship, orthopaedic research fellowship, and orthpaedic residency at that university's hospital from 1992 to 1997. In 1998, Dr. Gabriel had a fellowship in adult spinal cord injury at Case Western Reserve University. He arrived at Ohio State in 2004.

His many clinical interests include: revision spine surgery; surgical myelopathy; cervical lumbar degenerative disorders; adult spinal cord injury; and kyphoplasty.

Dr. Gabriel's research pursuits include: micro-discectomy; laminectomy; fusions; spinal instrumentation; vertebroplasty, kyphoplasty; and surgical treatment of spinal rheumatoid arthritis.

Dr. Gabriel can be reached at 614-293-2808 or josue.gabriel@osumc.edu.

In *This* Issue . . .

C/S/E/L Offers Podcasts

Ohio State's Cognitive Systems Engineering Laboratory has begun using podcasting to capture and share material on topics related to their research.

Currently, **Dr. David Woods** offers two podcasts:

1. His plenary talk, *The Laws of Stretched Systems in Action: Exploiting Robots*, from the first annual Human-Robot Interaction Conference 2006; and
2. His contributions to the U.S. Senate Hearing podcast on C-SPAN, *Organization at the Limit: NASA and the Columbia Disaster*.

These are two examples of how everyday technology is changing how humans capture and share information.

These podcasts can be viewed at: http://csel.eng.ohio-state.edu/podcasts/woods/.

Joint Cognitive Systems: Patterns in Cognitive Systems Engineering

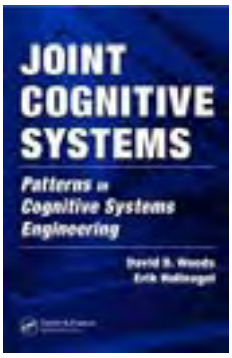
Institute member **Dr. David Woods**, Co-Director of C/S/E/L, has published a new book, along with co-author Erik Hollnagel.

Synthesizing basic results on how to design human work with complex systems, *Joint Cognitive Systems: Patterns in Cognitive Systems Engineering* provides examples of successful cognitive systems engineering research and design.

This book covers patterns in how joint cognitive systems work and those that have emerged from research and design in this field.

The authors discuss basic findings or control laws that determine the behavior and performance of joint systems. They also explore how to design joint coverage systems.

This text will be of great use by human factors practitioners who are charged with finding solutions that can ensure the safe functioning of technological systems.



Publisher: CRC Press (March 27th, 2006)
ISBN: 0849339332
List Price: $99.95

IN THE NEWS


Knapik

Gregory Knapik presented the lecture, *Loads on the Lumbar Spine during Pushing and Pulling Tasks*, at the 52nd Annual Meeting of the Orthopaedic Research Society in Chicago, Illinois (March 19th, 2006). **William Marras** and **Josue Gabriel** were co-authors of this research.

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Gary Allread represented the Institute by exhibiting at the 2006 Kentucky Governor's Safety & Health Conference and Exposition in Louisville (May 10th-12th, 2006). In addition, he was invited to give four lectures:

- *A Look at the Ergonomics "Big Picture": Understanding the Types of Factors Related to Injury Risk*
- *How to Integrate Ergonomics into Business Operations*
- *Using Ergonomics to Identify and Prevent Low Back Disorders in the Workplace*; and
- *Essentials of Workplace Ergonomics: How Musculoskeletal Disorders Develop, and Methods to Reduce Injury Risk*

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William Marras has been busy on the lecture circuit. He recently gave these talks:

- *The Working Back* - Keynote Address at the 6th Annual Safe Patient Handling Conference, Clearwater Beach, FL (February 28th, 2006).
- *Low Back Disorder Risk During Patient Handling* - Keynote Address at the Alaska State Nurses Conference, Anchorage, AK (March 31st, 2006).
- *Lumbar Spinal Biomechanics in Industrial Settings: Ramifications for Discogenic Injury*, and
- *Functional Assesment of the Patient Suffering from Lumbar Axial Pain* - First Annual Central Virginia Spine Symposium, Richmond, VA (April 28th, 2006).
- *Biomechanics of Low Back Disorders* - University of Chicago, Surgery Grand Rounds, Chicago, IL (May 10th, 2006).

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2nd Symposium on Resilience Engineering

November 9th - 11th, 2006 Cannes, France

Call for Papers

For this upcoming symposium, papers are solicited that address one or more of the following issues:

- How people and organizations can remain sensitive to the possibility for failure;
- Model-based measures of resilience and/or performance indicators;
- Analyses of the unanticipated consequences of change - how improvements can create new paths to failure;
- The impact of overconfidence and mis-understandings in safety and risk management;
- Description of the trade-offs and adjustments people and organizations habitually make to cope with the complexity and unpredictability of their working environment;
- Practical examples and/or field studies of resilience - or the spectacular lack thereof;
- The relation between resilience and quality management (e.g., Kaizen);
- Organizational safety and enterprise resilience;
- Building resilience into information technology and software.

Deadlines

- Submission of extended abstracts: July 7th, 2006
- Final submission of full papers: October 9th, 2006

More information about Resilience Engineering, and this symposium, can be found at www.resilience-engineering.org.

Woods Featured in *HFES Bulletin* Article on IT Service Delivery

The March, 2006 lead article of the *HFES Bulletin* focused on human factors challenges with automating information technology (IT) services. They represent one of the fastest-growing segments of the services industry in the U.S. and typically are business-to-business, rather than the more traditional business-to-customer service provided by such industries as fast food, entertainment, or health care.

Because over 70% of the U.S. labor force provides services, this is a lucrative business to be in; however, there are major challenges yet to be solved. IT solutions are becoming increasingly complex, and the costs of managing such systems often outpace the initial investment to develop the technology.

The IT service industry's approach to controlling costs includes *standardization*, *integration* (or consolidation), and *automation*. However, the opportunity for larger cost savings and improved service quality is believed to be through the effective use of automation. Because most IT systems management activities still are highly manual, human factors can contribute significantly in designing successful, effective automation for IT systems. Unfortunately, how highly automated IT systems interact with all the various aspects of IT delivery service is not yet well understood.

Woods

David Woods, Institute member and Co-Director of OSU's Cognitive Systems Engineering Laboratory (C/S/E/L), participated in a panel session on these issues, which took place during the HFES 49th Annual Meeting. Other speakers on the panel, titled "*Human Interaction with Autonomic Computing Systems*," included Alva Couch (Tufts University), Asaf Degani (NASA Ames Research Center), and Christopher Miller (SMA Information Flow Technologies).

The panel delved into many questions, including:

- Does automation for IT solutions pose unique human factors challenges compared with automation in other domains, such as air traffic control, aviation, military systems, power plants, transportation, manufacturing, and space exploration?
- What is unique about automation in IT systems?
- What do we know that can be applied to automation in IT systems?

All panelists introduced some element of existing knowledge or techniques for improving the human factors of automation. These elements included contrasting semantic-based planning versus policy-based planning, management of increased interaction complexity caused by automation versus simplification, and abstraction and simplification of system interfaces. They generally agreed that, at this point, there is no grounded theory that provides a framework for human interaction with automated IT systems. However, the lack of system transparency, observability, and resilience are issues that must be addressed to have an effective balance between the human and differing degrees of automation.

The complete text of the article written by John Bailey and Cheryl Kieliszewski (IBM Almaden Research Center) can be found at the HFES web site, www.hfes.org/Web/BulletinPdf/0306bulletin.pdf.

Graduate Student News

Graduating Student

Jeffrey A. Hoyle received his Masters Degree in June, 2006. Under advisor William S. Marras, Jeff's thesis involved, "Effects of Postural and Visual Stressors on Trigger Point Development, Muscle Activity, Blink Rate, and Discomfort during Computer Work."

Since graduating, Jeff has taken a position of Ergonomics Consultant with The Ergonomics Center of North Carolina in Raleigh. He can now be reached at hoyle@TheErgonomicsCenter.com. Congratulations, Jeff!

New Student

Lee Mazurek
(mazurek.4@osu.edu)
Advisor: William Marras
Hometown: Columbus, OH

Lee received his BS in Mechanical Engineering here at Ohio State. His research background and interests are in data driven simulation and modeling. Lee's Masters project will be the development of a biomechanical model of the shoulder.

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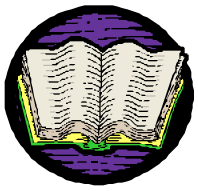

Recent publications written by Institute members (indicated in boldface font) include:

An Exploratory Study of Loading and Morphometric Factors Associated with Specific Failure Modes in Fatigue Testing of Lumbar Motion Segments

Sean Gallagher, **William S. Marras**, Alan Litsky, and **Deb Burr**, *Clinical Biomechanics*, 21(3): 228-234, 2006.

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Baggage Handling in an Airplane Cargo Hold: An Ergonomic Intervention Study

Sahika Vatan Korkmaz, **Jeff A. Hoyle**, **Greg G. Knapik**, **Riley E. Splittstoesser**, **Gang Yang, David R. Trippany**, Parul Lahoti, **Carolyn M. Sommerich**, **Steven A. Lavender**, and **William S. Marras**, *International Journal of Industrial Ergonomic*, 36(4): 301-312, 2006.

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Changes in Spine Loading Patterns throughout the Workday as a Function of Experience, Lift Frequency, and Personality

Anne-Marie Chany, Julia Parakkat, **Gang Yang**, **Deb Burr**, and **William S. Marras**, *The Spine Journal*, 6(3): 296-305, 2006.

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Compliance with Intended Use of Bar Code Medication Administration in Acute and Long-Term Care: An Observational Study

Emily S. Patterson, M L. Rogers, R. J. Chapman, and M. L. Render, *Human Factors*, Special Issue on Patient Safety, 48(1): 15-22, 2006.

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Design as a Prediction Task: Applying Cognitive Psychology to System Development

Philip J. Smith, R. B. Stone, and **Amy Spencer**, in W.S. Marras and W. Karwowski (eds.), *Handbook of Industrial Ergonomics*, 2nd edition, New York: Marcel Dekker, Inc., 24-1 - 24-18, 2006.

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Does Personality Affect the Risk of Developing Musculoskeletal Discomfort?

W. Gary Allread and **William S. Marras**, *Theoretical Issues in Ergonomic Science*, 7(2): 149-167, 2006.

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Myofascial Trigger Point Development from Visual and Postural Stressors during Computer Work

Delia Treaster, **William S. Marras**, **Deb Burr**, **James E. Sheedy**, and Dennis Hart, *Journal of Electromyography and Kinesiologyumans*, 16(2): 115-124, 2006.

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Spinal Loading During Manual Materials Handling in a Kneeling Posture

Riley E. Splittstoesser, **Gang Yang**, **Greg G. Knapik**, **David R.Trippany**, **Jeff A. Hoyle**, Parul Lahoti, **Sahika Vatan Korkmaz**, **Carolyn M. Sommerich**, **Steven A. Lavender**, and **William S. Marras**, *Journal of Electromyography and Kinesiology*, available on-line March, 2006.

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Spine Loading as a Function of Lift Frequency, Exposure Duration, and Work Experience

William S. Marras, Julia Parakkat, Anne-Marie Chany, **Gang Yang, Deb Burr**, and **Steven A. Lavender**, *Clinical Biomechanics*, , 21(2): 345-352, 2006.

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Reviews of Human Factors and Ergonomics, Volume 1

The Human Factors and Ergonomics Society has published the first volume in their new annual series. It provides HF/E information in specific subject areas to give a comprehensive understanding of each topic, including current states, new research findings, new technology, and current issues & research needs.

These *Reviews* will focus on real world applications, such as the design of devices, systems, or processes that people use or interact with. Volumes in the series will highlight both research and practice.

Volume 1, edited by Raymond S. Nickerson, highlights three research areas: biomechanical modeling; human-automation interaction; and technology & aging, and emphasize three applications: driving safety; product safety & effectiveness in the home; and reducing & mitigating human error in medicine.

Single copies of this volume are $80 for HFES members, with discounts for purchasing larger quantities. Members of societies affiliated with the International Ergonomics Association are entitled to purchase copies at the HFES member price.

Ordering information: www.hfes.org/Publications.

Hotel Amenities

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600 housekeepers, which found that 91% had experienced workplace pain, and 67% said the pain was so severe that they sought medical treatment. These employees often complain of pain in their backs, shoulders, and wrists.

Ferguson

Sue Ferguson, Senior Research Associate/Engineer in Ohio State's Biodynamics Laboratory, led an effort to determine the low-back injury risk associated with many hotel room cleaning tasks. Under the direction of **William Marras**, she and **Gary Allread**, the Institute's Program Director, used the Lab-developed Lumbar Motion Monitor (LMM) on a representative sample of experienced housekeepers doing their jobs in a Columbus-area hotel.

Various bed-making tasks, such as lifting mattress corners to make beds, changing sheets and pillowcases, and handling pillows, were studied. Bathroom-cleaning tasks, notably scrubbing bathtubs, tiles, floors, toilets, and sinks, also were recorded as employees wore the LMM. Additional housekeeper duties studied were vacuuming, dusting, and pushing supply carts.

The data were input into the LMM's low-back injury risk model, and the investigators were surprised by the findings. These housekeepers had jobs that produced a higher risk of back disorders than car door assembly tasks performed by automobile workers. Items lifted by housekeepers were low in weight, compared to industrial jobs. However, trunk motions generated by these employees, particularly forward (sagittal) flexion and velocities in the side-bending (lateral) and twisting (transverse) planes, were much higher than seen in many other industries. This, combined with the high frequency of work tasks required, produced these high injury risk values.

Dr. Ferguson and other Institute members are gathering additional data to more fully understand this job's injury risk. More details about the initial study can be found on the Biodynamics Lab's web site, http://biodynamics.osu.edu/research.html, or by contacting Sue Ferguson (ferguson.4@osu.edu).

Research Corner

This issue of the Bulletin summarizes recently published research

Spinal Loading During Manual Materials Handling in a Kneeling Posture

R.E. Splittstoesser, G. Yang, G. G. Knapik, D.R. Trippany, J.A. Hoyle, P. Lahoti, S. Vatan Korkmaz, C.M. Sommerich, S.A. Lavender, and W.S. Marras

Journal of Electromyography and Kinesiology, March, 2006

Abstract: Stooped, restricted, kneeling, and other awkward postures adopted during manual materials handling have frequently been associated with low back pain onset. However, lift assessment tools have focused on materials handling performed in an upright, or nearly upright standing posture. Unfortunately, many of the tools designed to analyze standing postures are not easily adapted to jobs requiring restricted postures. Therefore, the objective of this study was to evaluate spinal loading during manual materials handing in kneeling postures and determine if those loads can be predicted using simple regression.

An EMG-driven biomechanical model, previously validated for upright lifting, was adapted for use in kneeling tasks. Subjects knelt under a 1.07 m ceiling and lifted luggage of six weights (6.8, 10.9, 15.0, 19.1, 23.1, and 27.2 kgf) to one of four destination heights (0, 25.4, 53.3, and 78.7 cm).

Spine loading was significantly affected by both destination height and load weight. Destination height increased compression, anterior-posterior (AP) shear, and lateral shear by an average of 14.5, 3.7 and 6.6 N respectively per cm height increase. Load weight increased compression, AP shear, and lateral shear by an average of 83.8, 27.0 and 13.1 N respectively per kgf lifted.

Regression equations were developed to predict peak spine loading using subject height, load weight and destination height with R^2 values of 0.62, 0.51 and 0.57 for compression, AP and lateral shear respectively.

Myofascial Trigger Point Development from Visual and Postural Stressors during Computer Work

D. Treaster, W.S. Marras, D. Burr, J.E. Sheedy, D. Hart

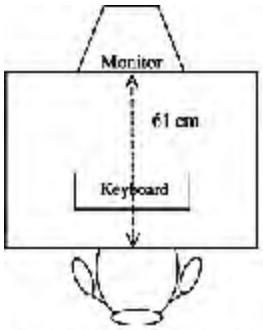
Journal of Electromyography and Kinesiology, 16(2):115-124, 2006

Abstract: The mechanism of musculoskeletal pain underlying low-level static exertions, such as those experienced during computer work, is poorly understood. It was hypothesized that static postural and visual stress experienced during computer work might contribute to trigger point development in the trapezius muscles, resulting in myofascial pain.

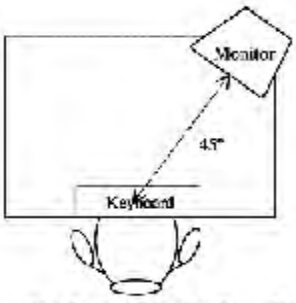
A study was conducted to observe the development of myofascial trigger points while 16 female subjects used a computer under conditions of high and low postural and visual stress. Trigger point development was monitored via expert opinion, subject self-report, and electromyographic activity.

Only the high visual stress conditions resulted in greater trigger point sensitivity as reported by subjects and a myofascial specialist. Cyclic trends in median frequency of the EMG signal were assessed for the trapezius muscle. When high visual stress was combined with low postural stress condition, there were significantly fewer cycles (1.6 cycles), as compared to the condition of low visual and low postural stress (2.8 cycles), and the condition of high visual and high postural stress (3.5 cycles). These significant differences between conditions were found for the right trapezius but not for the left.

The findings suggest that high visual stress may be involved in the development of the myofascial pain response.



Low Postural Stress Condition (PL)
Monitor directly in front of subject
Top of screen at subject's eye level



High Postural Stress Condition (PH)
Monitor at 45° to subject's right
Bottom of screen at subject's eye level

Effects of Postural and Visual Stressors on Trigger Point Development, Muscle Activity, Blink Rate, and Discomfort during Computer Work

Jeffrey A. Hoyle, Masters Thesis

Abstract: Computer use involves low level static exertions that may be influenced by the postural parameters of the workstation. The mechanisms of musculoskeletal pain and visual discomfort underlying low level static exertions, like those during computer work, are poorly understood. It was hypothesized that static postural and visual stress experienced during computer work might synergistically contribute to trigger point development, resulting in myofascial pain and symptoms of eyestrain.

Six male and six female subjects participated in a study simulating computer work. Each performed a typing task under high and low postural and visual stress, in three separate one-hour sessions. Musculoskeletal measures included trigger point develoment, electromyographic (EMG) activity, and self-reported discomfort.

Cyclic changes in the EMG median frequency, representative of motor unit rotation, and a central tendency measure were used to assess EMG activity at multiple muscle locations on the trapezius. A multi-channel array was used to monitor EMG differences between muscle spatial locations relative to the trigger point. Visual measures included EMG activity of the orbicularis oculi, blink rate, accommodation, and self-reported visual discomfort.

Myofascial trigger points developed in all subjects regardless of the stress condition. The most interesting finding was the interaction between postural and visual factors on both the musculoskeletal and visual systems. Both high postural and high visual stress conditions resulted in significantly fewer cyclic changes in median frquency (i.e., less motor unit rotation) across the trapezius, and reduced blink rate compared to the baseline low stress condition. Spatial location relative to the trigger point site on the trapezius influenced EMG patterns.

Results have shown the importance of considering *both* postural and visual factors to understand the nature of the health effects during computer work. Disorders related to this work may be influenced by the complex interaction between the physical and visual parameters of the task.

A hypothesized injury pathway model leading to myofascial pain, MSDs, and visual system disturbanced during computer work was presented. A central stress theory involving the autonomic nervous system was proposed to be the interactive mechanism affecting both musculoskeletal and visual loading. However, efforts to further understand the mechanisms through which this interaction occurs are needed.