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Editorial

Honoring Dr. Vincent Matthew Ciriello special issue guest editorial

Honoring Dr. Vincent Matthew Ciriello
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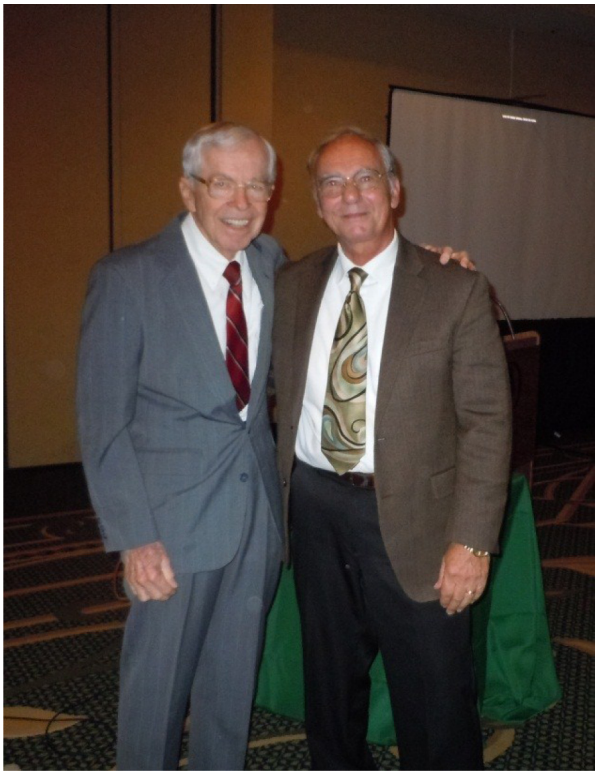
This special issue is in honor of the career contributions of Dr. Vincent M. Ciriello, recently retired from the Liberty Mutual Research Institute for Safety.

Dr. Vincent Ciriello graduated with a Bachelors in Biology, Masters in Health Dynamics, and Doctorate in Applied Anatomy and Physiology, all degrees from Boston University, Boston, USA. Dr. Ciriello conducted research investigations in psychophysics and low-back and upper extremity musculoskeletal health and disorders for 44 years. Dr. Ciriello's research resulted in the internationally recognized "psychophysical tables" (the "Snook and Ciriello Tables", 1991) and advanced our understanding of the acute responses of industrial populations, with and without low-back pain, to materials handling and other physical stimuli. The psychophysical findings were foundational to the 1981 and 1991 NIOSH Lifting Equations as well as the ISO 11228, Manual Materials Handling part 2-Pushing and Pulling standard. Both tools are used globally to address the significant burden of materials handling injuries in occupational settings.

The heart of Dr. Ciriello's contributions was the improvement of the ergonomics and safety of workplaces around the world. The psychophysical tables gave practitioners the scientific evidence base to assess workplace manual materials handling risk with the goal of implementing ergonomics design interventions that improve workplace safety and productivity. The title of the journal articles published by Snook in 1978 and Snook and Ciriello in 1991 says it all: "The Design of Manual Handling Tasks". What many might not know is that Drs. Snook and Ciriello developed a set of proprietary tables used internally by Liberty Mutual Loss Prevention field consultants for many years based on the same research as published in the articles. The output of these tables were population percentages for males and females able to perform the task, rather than the maximum acceptable weights and forces. In 1978, a document titled "Manual Materials Handling Task Evaluation Ergonomic Tables" was released within Liberty Mutual's loss prevention department and, in 1991, the revised research led to a revised tool called "Manual Materials Handling: Ergonomic Tables". This document was later developed into an internal computer application called CompuTask™. These tables are now openly available as an on-line calculator on the Liberty Mutual Research Institute for Safety website as the "Liberty Mutual Tables". This calculator is but one of many manual materials handling calculators developed by practitioners around the world based on the work of Snook and Ciriello. It is impossible to know how many jobs are now safer because of their work, but it is significant. We are very grateful the contributions of Drs. Snook and Ciriello.



With Dr. Stover Snook during Dr. Ciriello's Retirement Party (October 24, 2013).

As a colleague, Dr. Ciriello brought an impeccable knowledge of physiology to each study as well as experimental rigor and attention to detail. He insisted on using age-relevant subjects representative of working populations, and believed that training was critical so that the results reflected working conditions. Even by early standards of practice in ergonomics research, the number of subject hours and comprehensiveness of protocols were exemplary. The mentoring of younger researchers throughout the years will have a lasting impact. As important as the scientific contributions are, we'll always be appreciative of the fun and camaraderie we had working with Vince as we sought to make workplaces safer.

This special issue contains 17 papers on a variety of topics that are passionate to Dr. Ciriello's research interests. The first three papers deal with psychophysics in upper extremity work. An excellent summary of psychophysical concepts is written by **Fernandez and Marley**, who delineate the basic relationship of perceptual responses and stimuli in determining thresholds and, in particular,

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their applicability in ergonomics research. These authors further emphasize the efficacy of psychophysics in upper extremity work-related investigations. **Deal and Bernard** report maximum acceptable frequencies for hand/arm motions during manual assembly of connectors that are encountered in automotive manufacturing plants. Interestingly, a majority of psychophysical studies published in the literature report the relationship between the perceptual responses as a function of physical stimuli. However, it is not clear how performing a task at and above an individual's acceptable workload will influence physiological responses. To this effect, **Maikala and colleagues** demonstrate that upper extremity muscle hemodynamic responses are similar when participants work at and above their psychophysical workload during a repetitive ulnar deviation task.

The next four papers are on repetitive lifting. **Pinder and Boocock** utilize an extensive search strategy to identify the relationship between the maximal acceptable weight and the frequency of lift for both men and women. These authors present predictive models for the maximal acceptable weight of lift from the frequency of lifting. Combining psychophysics and physiology, **Fox and Smith** assess the influence of arm lifting of light loads, specifically at high frequencies, on both perceptual and physiological responses. These authors also report that the heavy and medium weight participants chose higher frequencies as compared to the light weight participants. The revised National Institute of Occupational Safety and Health (NIOSH) lifting equation, although it has inherent limitations, has been instrumental in work (re)design and injury prevention. **Potvin** questions the conservative nature of the recommended weight limits from the revised NIOSH lifting equation to various combinations of a lifting task, and presents an alternative approach consisting of composite acceptable loads for a variety of lifting conditions. One of the most overlooked body regions with respect to work-related musculoskeletal disorders research is the neck region, especially during lifting-related tasks. **Nimbarte** demonstrates the importance of studying biomechanical loading of the neck muscles in both men and women during a variety of lifting task combinations. Load carriage is an integral part of activities of our daily living (e.g., carrying groceries) as well in the workplace (e.g., carrying a sand bag). **Pal and coworkers** examine the optimal load to be carried by the Indian infantry soldiers at different combinations of gradients and walking speeds.

The next three papers are on the psychophysics related to pushing and pulling. **Fischer and Dickerson** present insights gained by linking psychophysics and biomechanics in understanding injury mechanisms as a function of task-related factors, specifically with respect to the shoulder region. Presenting a few case studies, these authors reiterate how biomechanical demand can influence psychophysically chosen workloads. Utilizing a computationally-derived biomechanical model for the shoulder, **Steele and colleagues** compare biomechanically based pushing guidelines to that of the psychophysical pushing tables developed by Snook and Ciriello. Replacing lifting and lowering activities with pushing and pulling in the workplace is often advocated, however research pertaining to these activities and their influence on the low-back and upper extremity are still at initial stages. **Garg and colleagues** present regression equations to estimate initial and sustained pushing/pulling forces as a function of push/pull handle height, frequency and distance of push/pull, and argue that these results are acceptable to 75% of male and female working populations.

Muscle fatigue is still a highly explored topic in ergonomics-related research. **Zhang and colleagues** employ a theoretical model of muscular strength and maximum endurance time to examine their role in muscle fatigue and compare these variables with empirical models that are available in the literature. Utilizing discrete event simulations, **Perez and colleagues** present an innovative approach to predicting operator's mechanical exposure and subsequent fatigue over a whole shiftwork. Their aim is to develop a proactive tool for facilitating ergonomics analysis at the early stages of system design, before exposure to work, as well as using it as a reactive tool in analyzing the presence of ergonomic risk factors.

A variety of job evaluation techniques are available in the ergonomics literature to identify individual work practices that might contribute to the risk of injury while working. The following three papers discuss such techniques. **Dasgupta and colleagues** provide a task-based ergonomics exposure assessment of selective construction-related jobs. Utilizing the work sampling observation method – Posture, Activity, Tools and Handling – these authors identify several physical risk factors in drywall workers. **Douwes and colleagues** develop a risk assessment tool, known as Hand Arm Risk Assessment Method, to evaluate neck and upper limb musculoskeletal disorders. In another manuscript, using the hand arm-related data collected from a three year prospective cohort study, **Douwes and colleagues** report the predictive validity of the risk assessment method as well. In the final paper on work-related low-back pain, **Govindu and Babski-Reeves** examine the importance of considering a combination of occupational, personal and psychosocial factors in developing predictive models for understanding the injury mechanisms as well as in developing ergonomic interventions.

We thank the authors and their colleagues for sharing their excellent work in this issue. We are appreciative of the reviewers for their detailed as well as constructive criticism of the submitted manuscripts. The qualities of these manuscripts are a testament to the authors' appreciation of this great scientist's contribution to science, and his warm and laid-back personality. Special thanks go out to **Dr. Stover Snook** for his thoughtful commentary. More importantly, this special issue would not have been possible without the enthusiastic support and encouragement from **Dr. Anand K. Gramopadhye, the Editor-in-Chief**. Our hope is that you will enjoy reading this special issue as much as we have enjoyed compiling it. Happy retirement, Vince!

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