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Neuroergonomics: Harnessing the Power of Brain Science for HF/E

By Raja Parasuraman & Peter A. Hancock

During its relatively short history, human factors and ergonomics (HF/E) has been associated with shifting approaches to its basic science and practice. HF/E began as an extension to the time-and-motion methods introduced by Frederick Taylor’s “scientific management.” In the World War II era, HF/E was strongly influenced by the behaviorist approach to psychology. The so-called cognitive revolution in the 1960s displaced behaviorism and established the ascendancy of the human information-processing approach in HF/E, a tradition that remains strong today.

Most recently, many HF/E researchers have turned to ecology and anthropology to observe “cognition in the wild” – that is, in its natural context at work rather than in laboratory settings. Although none of these paradigms has a dominant position in current HF/E, most would agree that understanding human cognition and action in relation to the use of technology lies at the core of the discipline.

Over the past two decades there has been another revolution – in cognitive neuroscience – that has radically expanded our understanding of human cognition. As a result, it is no longer possible to describe the features of cognition and action at a scientific level (as opposed to a prescientific, observational level) without some reference to human brain processes (Posner, 2003). The time has therefore come to harness this knowledge to the benefit of HF/E research and practice – hence *neuroergonomics*.

What Is Neuroergonomics?

Neuroergonomics involves an examination of the neural bases of such functions as seeing, hearing, attending, remembering, deciding, and planning in relation to technologies and their functioning in the real world. Given that cognition is situated in a physical world with which the brain interacts through the body, neuroergonomics is also concerned with the neural basis of physical performance: grasping or lifting objects and controlling one’s limbs (Karwowski, Sienionow, & Gielo-Perczak, 2003). Investigations of how the brain carries out the complex tasks of everyday life can benefit both research and practice in HF/E. Similarly, consideration of HF/E issues can extend the ecological validity of cognitive neuroscience.

The term *neuroergonomics* was coined seven years ago to depict this emerging, interdisciplinary area of research and practice. In

the interim there have been two special issues of a journal devoted to the topic (Parasuraman, 2003), workshops (International Ergonomics Association in 2003 and the forthcoming Augmented Cognition International Conference in 2005), editorial commentary identifying neuroergonomics as a “burning issue” for contemporary ergonomics (Marek & Pokorski, 2004), discussions of the scientific status (Sarter & Sarter, 2003) and societal implications of neuroergonomics (Hancock & Szalma, 2003), and popular descriptions of neuroergonomic research (Huff, 2004). The first technical book devoted to the subject will appear next year (Parasuraman & Rizzo, in press).

Neuroergonomics involves the intersection of two disciplines that have rarely communicated in the past: neuroscience and ergonomics. The relative neglect by ergonomists of human brain function is reasonable given that this discipline had its roots in behaviorist psychology. That neuroscience did not consider human behavior in complex environments is also understandable given that the neural mechanisms of human cognitive functions have been identified only recently. Neuroscientists are not standing still, however, as witnessed by calls to move neuroscience “beyond the bench” (Editorial, 2002), the rise of a neuroscience of social behavior (Caccioppo, 2002), and the development of neural prosthetics for control of robots, home automation, and other technologies for physically disabled people (Musallam, Corneil, Greger, Scherberger, & Andersen, 2004; Mussa-Ivaldi & Miller, 2003).

Neuroergonomics, Embodied Cognition, and Technology

Until recently, cognitive science ignored neuroscience, consistent with a functionalist philosophy of mind (Dennett, 1991). In the functionalist framework, mind is viewed as software, and the task of cognitive science was seen as identifying the characteristics and rules of the software, irrespective of hardware implementation (e.g., the brain). In contrast, the cognitive neuroscience view is that neural structure and function constrain and, in some cases, determine viable theories of cognition (Posner, 2003). This view has now come to influence all the cognitive sciences. Neuroscience has therefore freed cognitive science from rigid functionalism; in turn, neuroergonomics can liberate cognitive science from a disembodied existence devoid of context and thus provide it an anchor in the real world.

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Patient Safety Forum a Big Success

By Gerald P. Krueger, HFES Representative to FBPCS

By all measures, the Science Forum on Human Factors and Patient Safety, HFES's first cosponsored event with the Federation of Behavioral, Psychological, and Cognitive Sciences (FBPCS), was a huge success. On October 15, a dozen speakers and more than 50 attendees representing university, government, and private or corporate research centers from around the country gathered in the impressive new facilities of the National Academies of Sciences in Washington, D.C., to address issues of health care patient safety. A summary, photo, and links to the speakers' PowerPoint presentations may be found at <http://www.thefederationonline.org/PatientSafetyIndex.html>.

HFES President Wendy Rogers presided over a spirited all-day session that involved an interactive audience participating with speakers who described significant patient safety concerns with human factors implications, including issues of interactive communication problems in rendering health care, poor equipment and procedural design, insufficient labeling and color-coding schemes, inadequate instruction and training, and procedural design inadequacies. Highlights included patient safety issues not only in hospitals and nursing care centers but also in emergency medical care services, self-managed care, home monitoring, and the integration of new enabling technologies into the operating room and beyond.

Seminal research programs addressing national health care issues involving human error and design inconsistencies were highlighted. The audience was treated to frank discussion of patient safety research and applications. Funding opportunities (or the lack thereof) were presented by speakers representing key governmental sponsors of research on patient safety, including the Institute of Medicine, Food and Drug Administration, Veterans Administration, Department of Defense, and the Department of Health and Human Service's Agency for Healthcare Research and Quality.

A survey was distributed after the forum, and HFES received significantly positive feedback. Both researchers and funding agency representatives said they learned much new information about interesting and challenging human factors applications; they felt the forum brought about extensive dialogue among those who can do human factors research to make a difference with those who sponsor work on patient safety; and it whetted their appetites for more human factors research and applications work on this advancing national hot topic of patient safety.

HFES is the third largest member of FBPCS, which has 19 allied organizations representing the behavioral and social sciences. The Federation (<http://www.thefederationonline.org>) provides education, outreach, and advocacy on behavioral science issues, especially in the Washington, D.C., area.

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Science Forum presenters gathered for a group photo. Front row, from left: Helen Altman Klein, Daryle Gardner-Bonneau, Holly Jimison, Heidi King, Nancy Ostrove, Caroline Cao, Wendy Rogers. Back row, from left: Terry Fairbanks, James Battles, Philip Aspden, Robert Wears, Noel Eldridge, Kerm Henriksen, Lois Smith (HFES staff), Pascale Carayon.



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Some of the nearly 70 audience members and speakers. One attendee commented, "The event attracted a reasonably large number of people, and the people who came were important to meet and had interesting work going on." 

You Asked for Training Workshops: A Call for Proposals

By Patricia R. DeLucia, Chair, HFES Education and Training Committee

The Education and Training Committee invites proposals for a special full-day workshop to be held at the 2005 HFES Annual Meeting in Orlando, Florida. Proposals for workshops in the areas listed below are highly desired and urgently solicited. Additional details about submitting a workshop appear in the Call for Proposals, which may be found at the HFES Web site.

In 2003, the committee conducted a survey to assess the education and training needs of HFES members. Based on the survey results, the committee identified content and skill areas in which members perceived a need for further education and training (complete results can be viewed at <http://www.hfes.org/Memberdesk/survey.pdf>). Workshop proposals must address a need identified by the membership survey and will be subject to the normal technical review process. Discussions of leading-edge technologies that will stimulate interest and attendance are especially welcome. The workshop presenter(s) will be paid a \$1500 honorarium.

The following table lists the HF/E content and skill areas that were characterized as a training need by more than 50% of the survey respondents (total = 933). The table also shows percentages separately for students, academics, and practitioners.

Percentage of Respondents Indicating Need for Further Education and Training in Various HF/E Content Areas

	Overall	Student	Academic	Practitioner
Content Area				
Displays, GUI, signage	71	78	59	74
HCI	70	82	59	72
Cognition	64	78	57	64
Sensation-perception	64	74	59	64
Situation awareness	61	69	61	61
Training	61	75	57	61
Expert systems	60	76	56	59
Stress, fatigue	58	66	57	58
Individual differences	57	75	55	55
Workplace design	57	63	55	59
Warnings	55	65	49	57
Communication technology	53	58	50	55
Instructional technologies	53	53	54	54
Consumer products	52	62	54	51
Special populations	51	59	54	51
Skill Area				
Task/cognitive task analysis	71	83	68	71
Simulation methods/tools	65	82	60	64
Statistics/data analysis	65	84	63	64
Test and evaluation methods	65	81	56	66
Usability analysis	65	80	52	67

Applying HF/E principles	63	79	59	63
Workload measurement	63	82	61	62
Modeling	60	78	64	58
Project/time management	59	73	46	62
Systems analysis	59	69	51	61
Safety/risk assessment	58	64	54	59
Survey construction	56	67	56	56
Experimental methods	55	72	50	54
Human reliability analysis	55	69	54	54
Prototyping	55	66	45	57

The due date for all 49th Annual Meeting proposals is *February 8, 2005*. If you have questions about the Education and Training Committee special workshop, please contact Patricia R. DeLucia, pat.delucia@ttu.edu, 806/742-3711, extension 259.

Is a Poster Right for You?

By Haydee M. Cuevas, Annual Meeting Poster Session Coordinator

As planning begins for the HFES 49th Annual Meeting in Orlando next September, it's a good time to review the benefits of selecting the poster presentation format when you submit your proposal. This article aims to correct some misperceptions about the value of posters and to encourage you to consider submitting a poster.

Some meeting attendees seem to have the impression that research presented in poster sessions is of inferior quality and that submissions accepted as posters are typically student work or proposals that did not meet the high standards for acceptance in other presentation formats. Another incorrect assumption is that authors of posters do not submit a full paper in the proceedings. In fact, poster authors are encouraged to submit a five-page paper for the proceedings – HFES has been doing this since 2001! Members of the Technical Program Committee (TPC) have had to clarify this point to both technical group (TG) program chairs and authors who expressed concern based on the mistaken belief that the author's work would not be published in the proceedings.

As stated by one of the 2004 TG program chairs, "This is not good from the perspective of the HFES as many valuable topics may be getting ignored." To address this issue, the TPC has initiated a concerted effort to educate HFES members about the advantages of the poster presentation format and dispel the misconception that poster sessions are a second-class forum.

Consider this "Top Ten List of Questions about Why Posters Might Be Right for You":

1. Do you ever wish you had more time to discuss your work and receive more than two or three minutes of questions and feedback on your research?
2. Do you ever wish you had more time to provide thoughtful, in-depth responses to questions about your research?
3. Do you enjoy interacting one-on-one with people interested in your work?

continued on next page

4. Do you enjoy being in an open, dynamic setting that allows you to freely view the work of other researchers and practitioners whose research interests are similar to yours?
5. Do you believe in the adage, "A picture is worth a thousand words"?
6. Do you ever wish you had something really interesting to display in your lab or office that succinctly and visually summarizes your work—something to proudly show your visitors?
7. Do you find it difficult to sit in one position for long durations (e.g., a 90-minute lecture session) and wish you could have the freedom to move about?
8. Do you get really frustrated working with PowerPoint and wish there was a better way to present your findings?
9. Do you ever wish you didn't have to worry about technical problems during your presentation (e.g., computer crashing)?
10. Do you ever wish you could have all the advantages of a lecture presentation (e.g., presenting your work before a group of your peers, publishing a five-page proceedings paper) without all the hassles involved in preparing an oral presentation (see 8 and 9 above)?

If you answered "yes" to any of these questions, consider submitting your 2005 proposal for presentation in a poster session.

Still not convinced? The TPC is also exploring various approaches to increase the value that poster sessions add to the overall technical program. In the past, poster session scheduling has been organized according to the topic of the technical group. At this year's meeting in New Orleans, we experimented with a *thematic* approach, whereby posters were organized according to common themes or research topics (e.g., homeland security, decision support systems, visual perception, driving, usability/design, etc.), no matter which TG accepted them. The goal was to enable attendees to compare and contrast distinct but related approaches taken by different TGs to address similar research questions. Ideally, this approach would also foster multidisciplinary thinking, in that poster session attendees and presenters might see how the theories, methods, and findings of one TG are applicable to the problems being investigated by another.

The TPC plans to continue evaluating the benefits of this thematic approach at the HFES 49th Annual Meeting in Orlando. As you begin preparing your proposal for that meeting, carefully review the descriptions of the various presentation formats included in the Call for Proposals. The TPC invites you to consider whether a poster presentation format may indeed be just right for you!

For questions about the poster sessions, please contact me via e-mail at ha651622@ucf.edu.

Haydee Cuevas recently successfully defended her dissertation and will be receiving a Ph.D. in applied experimental and human factors psychology from the University of Central Florida in December. She served as the Poster Session Coordinator for the 2004 Annual Meeting in New Orleans and will continue in this role for the HFES 49th Annual Meeting in Orlando, September 26–30, 2005.

Neuroergonomics

(continued from page 1)

Neuroergonomics involves the examination of neural and cognitive processes in relation to the artifacts and technologies of the world that require the use of those processes. This view has many antecedents. Craik (1947) proposed a view of technology as representing an extension of human cognitive capability. (A modern version of this doctrine is the view that humans and intelligent computer systems constitute "joint cognitive systems"; see Hutchins, 1995.) Also relevant is Piaget's (1952) work on cognitive development in the infant and its dependence on exploration of the environment. In his cogent examination of *situated* cognition, Clark (1997) discussed the characteristics of an embodied mind that is shaped by and helps shape action in a physical world.

If cognitive science should therefore study the mind not in isolation but in interaction with the physical world, then it is a natural second step to ask how to design artifacts in the world that best facilitate that interaction. This is the domain of ergonomics. Neuroergonomics goes one critical step further. It postulates that the human brain that implements cognition and is itself shaped by the physical environment must also be examined in order to understand fully the interrelationships of cognition, action, and the world of artifacts.

In the brief number of years since the idea of neuroergonomics was proposed, many researchers have seen value in the approach, as testified by the increasing number of papers, workshops, and editorials on the topic. At the same time, however, there have been some criticisms. Eminent HF/E researchers (Bill Howell, John Flach, personal communications) have expressed the view that the development of neuroergonomics is further evidence of the "balkanization" of HF/E, a trend that should be resisted if the unity of the discipline is to be maintained.

These concerns are important but, with respect to neuroergonomics itself, misplaced. We do not see neuroergonomics as a separate subdiscipline within HF/E, and neither one of us has any desire whatsoever to set up a Neuroergonomics Technical Group within HFES, or make any other attempt to divide up the discipline. Rather, we see neuroergonomics as providing a new infusion of ideas and methods relevant to *all* aspects of HF/E, including physical ergonomics. The criticism would be valid only if the argument could be made that the human brain is *totally* irrelevant to basic and applied issues in HF/E.

We feel that such an objection can be easily countered. Even if the argument could be sustained that HF/E theory need not consider brain function, emerging examples of neuroergonomics applications indicate that HF/E practice must. One example that proves the assertion is the development of cognitive prosthetics for so-called locked-in patients, for the elderly, and for other people with physical impairments (Mussa-Ivaldi & Miller, 2003). Closed-loop brain-machine interfaces have been designed that can be used by these individuals to control devices in their home, such as lights, telephones, TV, personal computers, and robots. For such devices to work well, basic research also has to be done on how technology shapes neuronal learning mechanisms. Hence progress in this area clearly constitutes an example of the neuroergonomics view that (a) the human brain implements cognition and action, (b) the brain is itself shaped by the physical environment,

and (c) both brain and behavior (e.g., action) must be examined in order to understand fully how human cognition and action are coordinated with the world of artifacts.

Social Concerns

In closing, though we have highlighted some of the positive aspects of neuroergonomics, we are aware that this is not an area without concerns. Some concerns flow from more general issues about societal organization. Society must preserve a delicate balance between the needs of the individual and the needs of the collective (i.e., the government). Technology has a continuing and important role to play in preserving this balance. At present, technologies to monitor an individual are based on physical actions and speech, but could they be based on comprehension of an individual's thoughts alone? Theoretically this may be feasible, and if so, such neuroergonomic technologies could represent an invasion of privacy. However, we argue that this fear is unfounded because neuroergonomics seeks and takes signals that are largely formatted for output response anyway. We know of no way at present to distill the content of thought itself from any specific pattern of recordable brain activity, although this is certainly the aim of many in the neurosciences.

More generally, there is a long-term concern about the unitary nature of consciousness. A unified self is generally seen as a primary characteristic of human identity. If the unity of human experience is fractured for some reason, pathology can result. If we see neuroergonomics as a first step toward direct human-machine symbiosis, can human-human linkages mediated by a computational "middleman" be far away? This being so, does not neuroergonomics threaten what it is to be human?

These fears are part of a general concern for the future of technology and represent natural apprehension about the abuse of technology by those with a penchant to such abuse. It has been said that all technologies are morally neutral and are capable of use or abuse, depending on those who wield them. Although this is not necessarily true, the power of a full-fledged neuroergonomics science is something that must be carefully watched. Notwithstanding these concerns, we see great advantage in neuroergonomics and look forward to further progress in both basic research and applications in this nascent area of research.

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PEOPLE

Henry McIlvane "Mac" Parsons, 1912–2004

After suffering a stroke on July 16, Mac Parsons died at age 92 in Huntington, New York, where he had lived the past several years. Mac was one of the best-known and most beloved HFES members. We appreciate him, and we will miss him dearly.

Mac graduated with a degree in history from Yale University in 1933 and served as a Navy lieutenant commander commanding an LST transport boat during World War II. After the war, Mac obtained his master's degree in experimental psychology from Columbia in 1947 and earned his Ph.D. in experimental psychology from the University of California at Los Angeles in 1963. Early on, Mac worked as a New York newspaper reporter, later as an educator, and then variously as an industrial corporate human factors specialist, government consultant, and senior human factors staffer at Essex Corporation. He also worked for many years with HumRRO in Alexandria, Virginia.

Mac specialized in behavior analysis, which he parlayed into a role as president of his own school, the Experimental College of the Institute for Behavior Research (IBR), from 1974 to 1980. But Mac is probably best known for his prolific writings about our discipline. He published numerous book chapters and lengthy articles on the discipline of human factors, HF/E in industrial engineering applications, HF/E and robotics, teleoperation, manufacturing, and environments for the aging. His most frequently cited works were on the behavioral and psychological implications of the historic industrial psychology studies done at the Hawthorne electric

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plant; also much cited was his book *Man-Machine System Experiments* (Johns Hopkins Press, 1972), which comprehensively documented many of the seminal government and industrial lab experiments done by groups of interdisciplinary scientists at the Naval Research Laboratory, Lincoln Labs, Rand Corporation, System Development Corporation, MITRE Corporation, the Ohio State and Johns Hopkins Universities, the Applied Physics Lab, the Institute for Defense Analyses, and the Army's Combat Development Experimentation Center. Mac was not only a historian for our discipline, he contributed meaningfully for more than four decades to making that history.

In recognition of his numerous human factors contributions, Mac was elected a Fellow of HFES, the American Psychological Association (APA), and the Washington Academy of Sciences. He received APA Division 21's Franklin V. Taylor Award for distinguished career contributions, the HFES Jack A. Kraft Innovator Award, and the HFES President's Distinguished Service Award, which he cherished very much.

One of my own fond memories of Mac traces back to 1973, when I was a student at Johns Hopkins. Professor Alphonse Chapanis asked me to critique Mac's chapter manuscript on designing environments for the aged. Mac, then a gentleman over 60, and I had a lot of fun with that one, me helping him write about "aging." Little did we know then that it would strike up a 30-year friendship stretching into Mac's 90s, and now it is I who is past the age of 60 – ha!

Mac's hobbies included sailing, skiing, and travel. He remained an ardent skier into his 80s. Mac was beloved. He was ever ready with a joke or a few limericks, which he composed, collected, and published (many with double entendres).

Mac Parsons was a stable fixture at our annual meetings. His lectures and his participation in panel discussions were always packed. With his white beard and bald Mr. Clean look, Mac was one of the most recognized and well-liked grand old men of HFES. Who among us can forget the several years when Mac and Marjorie, his wife of 42 years – both then octogenarians – would kick off the first dance at our annual awards banquet.

We will miss you, Mac Parsons. And thanks for the decades of memories!

– Gerald P. Krueger ☒

HFES FELLOWS

Meet HFES Fellow Kenneth S. Teel

I hesitated to write this because I haven't been active in the human factors and ergonomics field for the past 34 years. I decided

to do so, however, primarily to mention the many fine people with whom I worked during my HF/E career. (They are listed in alphabetical order.)

Starting in 1950, I spent four years working for the U.S. Air Force Human Factors Operations Research Laboratories, headed by Karl Kryter, an outstanding scientist and one of the finest gentlemen I've known. I served as a member of a group at MacDill Air Force Base assisting in the evaluation of Strategic Air Command flight crews with assigned Russian targets and the training of air crews for the Air Force's first jet bomber: the B-47, now a distant memory! I also monitored a contract research program on flying and ground safety, which involved such eminent researchers as John Flanagan, Harry Older, and Neil Warren.

I next worked at Lockheed-Georgia as a member of a team helping to design instrumentation and operating procedures for the C-130, a plane that is still a workhorse today. At Lockheed, I worked with Jack Kraft when he first entered the HF/E field.

From there, I went to Douglas-Long Beach as a member of a group headed by George Long, one of the finest systems analysts I've met. While there, I shared an office with Mac Parsons, who, like the Energizer bunny, "just kept going and going."

I spent the last 11 years of my HF/E career at Autonetics, where I established and managed the human factors department. I was fortunate to be able to attract such outstanding people as Keith Hansen, Doug Harris, Bob Haygood, Richard Hornick, and Harry Snyder. The major programs on which we worked were Minuteman, Advanced Manned Strategic Aircraft, and F-111, as well as Doug's pioneering work in the manufacturing and quality assurance areas.

After 20 years in the HF/E field, I made a deliberate midcareer change and became a professor of management at Cal State University, Long Beach, where I was able to use my industrial and management experience to, I hope, make my classes more meaningful for my students.

I look back fondly on both my careers, largely because of the many fine coworkers and students with whom I interacted. ☒

CALLS FOR PAPERS

Safety Conference Call for Papers

Parks College of Engineering, Aviation, and Technology and the School of Public Health at Saint Louis University invite abstracts for the second Safety Across High-Consequence Industries Conference, September 20–22, 2005. The conference links aviation and health care to discuss safety from the perspectives of design, operation, maintenance, recovery, and emergency management. The goal of the Safety Across High-Consequence Industries Conference is to continue to provide a venue for these two disciplines to share theoretical concepts as well as pragmatic solutions. This conference will provide a venue for researchers as well as practitioners to share ideas in a professional forum.

The due date for submitting abstracts (150–200 words) is *February 14, 2005*. Please indicate whether the submission is a panel presentation or a formal paper. For more information, contact Dolores Seats, Parks College of Engineering, Aviation, and Technology, Saint Louis University, 3450 Lindell Blvd., St. Louis,

MO 63103, 314/977-8302, fax 314/977-8388, seatsda@slu.edu,
http://parks.slu.edu/msasm/conf_home.htm.

Workplace Health Call for Papers

The American Psychological Association, the National Institute for Occupational Safety and Health, the National Institute of Justice, the National Institute on Disability and Rehabilitation Research, and the U.S. Department of Labor will convene the sixth international conference on occupational stress and health, "Work, Stress, and Health 2006: Making a Difference in the Workplace," in Miami, Florida, on March 2-4, 2006, at the Hyatt Regency Miami Hotel. Continuing Education Workshops will be held on March 1.

The Work, Stress, and Health conference series is designed to address the constantly changing nature of work and the implications of these changes for the health, safety, and well-being of workers. Numerous topics of interest to industry, employees, and researchers are covered in the series including new employment contracts, workplace restructuring, long hours of work, work and family, workplace violence, workforce diversity, the aging workforce, cardiovascular disease and work, disability management, mass disaster and terrorism, best practices, and stress prevention programs.

The deadline for submitting workshop proposals is *April 1, 2005*. The deadline for posters, papers, and symposia is *May 1, 2005*. For more information, contact Wesley Baker, Conference Coordinator, American Psychological Association, Women's Programs Office, 750 First St., NE, Washington, DC, 20002-4242, 202/336-6033, fax 202/336-6117, wbaker@apa.org, <http://www.apa.org/pi/work/callforpapers.html>. 

RECENT TITLES FROM HFES:

Guidelines for Using Anthropometric Data in Product Design by the HFES 300 Committee

This is the first document to present a global approach to anthropometry, extending from the use of averages and percentiles to methods appropriate for more complex designs, such as multivariate analysis. Basic and advanced methodologies to properly apply anthropometric data are described, their advantages and disadvantages are explained, and illustrative examples are provided. 76 pp., 8.5 x 11", paperback, \$75 members, \$85 nonmembers, searchable PDF on CD-ROM, \$50 HFES members, \$60 nonmembers.



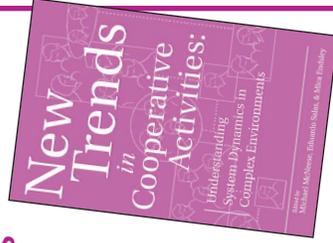
Humans and Automation: System Design and Research Issues by Thomas B. Sheridan

This book provides a historical context for human factors and automation and then describes how the two domains interact to ensure a system in which the human and machine operate with efficiency and safety. Includes appendices and an index. 278 pp., 5.5 x 8.5", paperback, \$42.95 HFES members, \$49.95 nonmembers.



New Trends in Cooperative Activities: Understanding System Dynamics in Complex Environments edited by Michael D. McNeese, Eduardo Salas, & Mica Endsley

In this multiperspective collection of original work, the editors have accomplished their aim to "foster a meeting of the minds of researchers and practitioners who have dreams about new visions of cooperative work and about the consequent support systems that are possible to enhance and improve cooperative work in dynamic ways." 17 chapters plus index. 328 pp., 7 x 10", paperback, \$45 HFES members, \$60 nonmembers.



Bulletin

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