UNDERGRADUATE HUMAN FACTORS CURRICULUM AND INTRODUCTORY HUMAN FACTORS COURSE CONTENT

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This panel provided a discussion format for six academic institutions to share their Human Factors (HF) curriculum and more specifically, to educate others on how they teach their introductory HF course. Each panelist addressed the following topics regarding their HF curriculum: foundation courses of the department's degree and specific HF courses offered. Then the panelists focused their discussions to their specific introductory HF course: philosophy; text book(s) used; course objectives; course syllabus flow; grading practices; and specific lesson exercises/labs.

INTRODUCTION

Dr. William Uttal (1998) presented a paper at the Applied Behavioral Sciences Symposium at the United States Air Force Academy entitled, "Engineers can kill you! Or why human factors scientists should run the show." The talk served many purposes, emphasizing more funding and getting HF specialists more involved, but a key aspect of the speech addressed furthering HF knowledge across all disciplines. Human Factors is still searching for its niche among better known academic disciplines. Unfortunately, many people do not discover human factors as a discipline until they are well into their graduate studies or even their careers.

Almost every undergraduate academic program involves a required course in psychology. This introductory course is designed to educate students in the basics of human behavior and social interactions, as well as possibly motivating students toward pursuing further academic study in one of the fields of psychology. The introductory psychology instructor must be knowledgeable of the different areas of applied psychology and the textbook should have information regarding the different areas as well. Martin and Wogalter (1997) presented a paper at the 1997 Annual Human Factors and Ergonomics Society meeting addressing this topic, "Students in the typical introduction to psychology course are likely to exit the course

knowing as little about human factors as when they entered" (Martin & Wogalter, 1997, p. 470).

Educating undergraduate students in their introductory psychology course is the first step towards informing students about human factors. The next step is to provide an undergraduate curriculum that includes human factors courses. Ellis and Goldberg (1992) investigated 27 undergraduate engineering programs to determine the structure and content of their introductory Human Factors Engineering (HFE) courses. They discovered what was currently being taught in HF courses. For instance, regarding textbooks, the Sanders and McCormick (1993, 1987) text was used by 40% of the programs that responded to their questionnaire. In terms of evaluating the students performance in the course, 66% was determined by some form of an exam, 10% by laboratory work, and 20% by projects. As far as the topics taught to the students in an introductory HF course the most common subjects were: anthropometry; displays; hearing/speech/noise; work physiology; and workplace design.

While Ellis & Goldberg (1992) were looking at what was *currently being taught*, Goldberg (1992) chaired a panel discussion at the HFES convention to discuss *what should be taught*. The objective of his panel was to bring academia and industry together to share views regarding topics and structure of an introductory HF course. The discussion produced the following list of panelists' academic desires to contribute most effectively to industry:

1. Wide breadth of topics rather than concentration on a few;
2. Research fundamentals;
3. Workplace evaluation;
4. Laboratory experiences; and
5. Final project with a presentation.

The United States Air Force Academy, Department of Behavioral Sciences and Leadership has recently conducted a curriculum review. The review entailed investigating other institutions programs and then comparing and contrasting them with our own department's programs. In accomplishing the curriculum review we discovered some schools that did not have an undergraduate HF degree but did have an introductory HF course. Those schools were: University of Wisconsin; Virginia Tech; North Carolina State; South Dakota School of the Mines; University of South Dakota; and University of Oklahoma. The following schools were those in our curriculum review that have an undergraduate HF program: University Of Illinois (Psychology Department); Wright State (Department of Biomedical and Human Factors Engineering); Embry-Riddle Aeronautical University (Applied Experimental Psychology); Cornell University (Department of Design & Engineering Analysis); Penn State (Industrial & Manufacturing Engineering); George Mason University (Psychology Department); and University of Idaho (Psychology Department). All of these programs have some form of research methods (statistics) course, cognition, memory, learning, sensation and perception, safety, and some variation of a human-computer interaction course. Also, depending upon which department "houses" the HF program, it drives other course offerings. Examples of other course offerings are: biomechanics; applied ergonomic methods; robotics; ambient environment; physiological psychology; and interactive systems modeling

A cornerstone to any educational major is the introductory course. This course must be broad-based, touching on numerous topics that lay the foundation for other courses in that particular field of study. Just as important as the specific ideas, concepts, and principles presented in the introductory course is the *manner* in which the material is presented. An introductory course needs to be interesting to the students because this is their first exposure to the subject matter. The challenge is to develop an introductory human factors course that is stimulating by presenting current technology and applied research (the bells and whistles), while incorporating the basic design principles and concepts (the potentially dry, but very important stuff).

Martin & Wogalter (1997) stated that many colleges and universities do not have faculty confident enough to teach an introductory HF course. They suggested that HFES provide an avenue for educating faculty and "...encourage expanded coverage of human factors engineering in

the undergraduate curriculum of institutions of higher education nationally" (p. 473). This panel may have been the first step towards getting HFES involved. Our objective was to share six university's HF curricula and introductory HF course specifics. By improving how we teach HF at the undergraduate level, larger numbers may enroll in graduate programs and carry the principles and practices of human factors into industry and beyond. This would then come full circle with increased interest in undergraduate HF programs.

FORMAT

The invited panelists were asked to discuss their institution's curriculum and introductory human factors course specifics in the following manner:

Major areas of curriculum to be addressed:

1. What department does your HF program fall under?
2. What are the foundation/core courses of the school's program/major?
3. What are the specific HF courses (include any optional courses within the HF track)?

The following questions address specifics of the Introductory Human Factors course:

4. Philosophy of the course – objective based or chapter based?
5. What text(s) is used?
6. Course objectives?
7. Course Syllabus flow?
8. Testing procedures?
9. Lesson specific exercises, video clips, labs?

Provided is an outline of the panelist's individual programs following the applicable previous 9 points. Due to limited space, item #7, course syllabus, will not be shown and other issues will have condensed amounts of information.

Binghamton – State University New York

1 – Psychology Department
2 – Intro, statistics, research methods, sensation/perception, cognition, learning, physiological psych
3 – Human factors psychology
4 – Chapter based on the textbook followed by group presentations in the second half of the course
5 – Payne & Wenger's Cognitive Psychology (1988), Wickens (1992), Kantowitz & Sorkin's Human factors, and Wickens, Gordon, & Liu (1997)
6 – Applicability of psychological research, basic HF principles, introduce interdisciplinary nature of HF work, analyze tools, devices, & systems from HF perspective
8 – 3 examinations, team projects, & small group projects
9 – Visits to HF labs in nearby companies (IBM, Lockheed-Martin, etc..)

Embry-Riddle Aeronautical University

1 - B.S. in Applied Experimental Psychology/Human Factors
2 – Research analysis & design, experimental psych, sensation/perception, cognitive psych, physiological psych, ergonomics & bioengineering, learning & motivation, IO psych, social psych
3 – Aviation psych, human-computer interaction, processes underlying cockpit resource management, HF in space, HF in Air Traffic Control, crew station design
4 – Stresses principles and fundamentals to introduce and excite students about research and the profession of HF
5 – Wickens, Gordon, & Liu (1997) and Casey (1998)
6 – Research, principles, and methods that are beneficial and essential in optimizing the interaction between people and machine elements of a system, while taking the environment into account
8 – Three exams and a comprehensive final, quizzes, and a term paper and presentation

9 – "Why planes crash" video, "The wrong stuff" video, term project conducting HF evaluation of an area on campus, and a display design evaluation exercise

North Carolina State University

1 – Psychology Department
2 – 9 hours of research, design, statistics, and labs
3. Ergonomics, graduate level courses as electives
4 – Perceptual & cognitive related topics, IE department teaches similar course but with a slant on the physical side
5 – Sanders & McCormick (1993), trying Wickens, Gordon, & Liu (1997), also have used Norman (1988) and Casey (1993, 1998) as supplemental
6 – Relationships between people, people's characteristics, limitations, and capabilities related to the design of equipment, products, environments, and work, improve productivity, satisfaction, and safety
8 – Exams, quizzes, homework, and group projects
9 – Simple data collection exercises, some out of the Sanders & McCormick workbook, create display posters using HF principles

Pennsylvania State University

1 – Department of Industrial & Manufacturing Engineering
2 – Work measurement & methods engineering & engineering statistics
3 – Human computer interface design & Safety systems engineering
4 – Sensory abilities, information processing, response limitations, physical/physiological limits, workplace evaluation
5 – Sanders & McCormick (1993), switching to Wickens, Gordon, & Liu (1997)
6 – Hands-on job evaluation & re-design, technical writing & communicating
8 – Exams, quizzes, final worth 55%, homework, labs
9 – All available on web site

University of Wisconsin - Madison

1 - Industrial Engineering Department
2 – Introduction to human factors
3 – Occupational safety & health engr, Ergonomics in manufacturing & industry, Design and human disability and aging, HF engr design & evaluation (sr capstone),
4 – Ergonomics, job design, & human-centered systems
5 – Sanders & McCormick (1993) & Bailey
6 – Critical thinking, systems evaluation, integration of HF in workplace & production processes, economic impact of poor HF practices
8 – Midterms & final group paper
9 – John Flach's manual Control Lab, used HFES proceedings for source material, and movie "Of men and machines" (Fitts Lab at Ohio St.)

United States Air Force Academy

1 – Department of Behavioral Science and Leadership
2 - Two semesters of research/statistics, learning, cognitive psych, anthropology/sociology, social psych, biopsych, I/O psych
3 - Intro HF, Aviation Psych, Engineering Psych, System Design (sr capstone), and then an elective course
4 – Previously used an objective based approach in 3 blocks of instruction following a perception-decision-action model
5 - Sanders & McCormick (1993) and Norman (1988) (switching to Wickens, Gordon, & Liu (1997))
6 - Think critically, think of the operator, human limitations & capabilities
8 – Two exams and a cumulative final, a final paper & presentation, critical article reviews
9 - T-37 aircraft mock-up for discussions on displays & controls, NOVA's "Why planes crash" video, The Learning Channel's "Survival in the sky: blaming the pilot" video, night vision and night vision goggle lesson demonstrations, Mannequin Pro software demonstration for anthropometrics lesson

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