PSYC 530

Cognitive Engineering: Human Factors in Systems

Fall 2006

Time: 4:30 pm – 7:10 pm Thursdays

Classroom: David King 2073A

Instructor: Raja Parasuraman
2055 David King Hall
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Email: rparasur@gmu.edu

Office Hours: 11-11:50 Wednesdays or by appointment (email).

Text: *Engineering Psychology and Human Performance (3rd edition),* C. D. Wickens & J. G. Hollands
Additional readings (journal articles and chapters) will also be distributed.

Prerequisites: An experimental psychology class or consent of instructor.

Objectives:

This course is designed to prepare incoming HFAC graduate students (although students in other programs are also welcome to enroll) by providing them with a basic background on the role of *human cognitive capabilities and limitations* in the design of products, work places, and large systems. The goal is to understand how perceptual and cognitive theories can be applied to diverse systems, from relatively simple devices such as personal computers to complex systems such as air-traffic control, aircraft cockpits, and nuclear power plants. The emphasis is on theories and findings on human performance, rather than the design of systems per se, although implications for design are continually analyzed.

Human factors is both a science and an approach to the design of systems. This course considers the scientific basis for human factors, particularly in relation to modern, semi-automated systems. The science of human factors considers various human characteristics and abilities, both physical and cognitive that are brought into play when people use machines. New approaches to understanding human performance based on neuroscience—the new field of *neuroergonomics*—are also briefly introduced. The goal of human factors is to design systems that match technology with human capabilities and limitations. The course has two objectives: (1) to examine several domains of human performance, with an emphasis on the information-processing approach to human perception and cognition; and (2) to investigate the role of human performance capacities and limitations in modern human-machine systems. Because modern human-machine systems increasingly make use of *automation* (computer assistance), another focus of the course will be on understanding the cognitive processes involved in human-automation interaction. The aim is to understand how certain perceptual and cognitive characteristics of human operators, for example the limited capacity of working memory or decision-making biases, influence the effectiveness of the performance of real-world systems.

Structure of Course

Each class will consist of a mix of lectures and participatory discussion, with the degree of the latter increasing over time as fundamental issues are further outlined in the lectures. I will lecture on each of several domains of human performance research, with appropriate references to applications to actual systems. Human performance in automated systems will be covered next. The final part of the course will consist of student presentations and discussions of specific topics related to human performance in systems.

Attendance Policy: Although I do not grade on attendance, this is a graduate level course and I expect (barring unforeseen circumstances) to see you in class each week.

GMU Honor Code: George Mason University has a code of Honor that each of you accepts by enrolling as a student. You should read and become familiar with this code at http://mason.gmu.edu/%7Emontecin/plagiarism.htm. The expectation is that all of the work you do for this class will be the work of one individual. However, you are fully encouraged to discuss the readings and topics raised in this class with your fellow students.

Students with Disabilities: If you are a student with a disability and you need academic accommodations, please see me and contact the Disability Resource Center (DRC) at 703-993-2474. All academic accommodations must be arranged through that office.

Exam Make-up Policy: You may take a test after the scheduled date only if you (a) receive my permission before the day of the test, or (b) have a valid excuse (e.g., a note from a doctor.). Papers will not be accepted beyond the due date. Homework assignments will not be accepted late.

Grading

Evaluation will be based on:
2 written tests (each 20%, one in-class, one take-home)
A written research (term) paper (30%)
A presentation of the paper (20%)
Classroom discussion (10%).

Total 100 points, letter grades as follows:

A: 90-100
A-: 87-89
B+: 84-86
B: 80-83
B-: 77-79
C: 70-76
F: 0-69

NOTE: IF YOU WISH YOU MAY SUBMIT THE TAKE HOME TEST AND THE TERM PAPER BY EMAIL TO rparasur@gmu.edu, BUT KEEP A HARD COPY AND GIVE ONE TO ME AS WELL.

Topics

History of human factors and the systems approach
Allocation of function
Signal detection
Vigilance
Attention, perception, and displays
Memory
Decision making
Attention and mental workload
Human performance in automated systems
Adaptive and adaptable automation

Note that because of time limitations not all aspects of human cognition that are relevant to human-machine systems will be considered, e.g., motor skills, language, stress and human error, spatial vision, etc. However, those of you who are interested in these or related domains of human cognition can nevertheless choose to study these as part of your presentation and term paper (described below).

TENTATIVE SCHEDULE

{Relevant chapters from Wickens & Holland and assigned readings are indicated}

August 31:	History of Human Factors The Systems Approach	**Ch. 1**
September 7:	Allocation of Function Information Processing and Human Performance	**Ch. 1**
September 14:	Signal detection	**Ch. 2,** Swets et al. (2000)
September 21:	Vigilance Test 1 (take home)	**Ch**. 2
September 28:	Attention and perception Test 1 due	**Ch. 3**
October 5:	Memory	**Ch. 7**
October 12:	Decision making	**Ch. 8,** Kahneman & Tversky (1974)
October 19:	Test 2 (in class)	
October 26:	Attention, time sharing, and workload	**Ch. 11**
November 2:	Human performance in automated systems.	**Ch. 13**, Parasuraman, Sheridan, & Wickens (2000)

LAST DATE FOR APPROVAL OF SEMINAR PRESENTATION AND TERM PAPER TOPIC!

November 9: CLASS PRESENTATIONS

November 16: CLASS PRESENTATIONS

November 23: Thanksgiving Holiday

November 30: CLASS PRESENTATIONS

December 7: Adaptive and adaptable automation. **Ch. 13**, Miller & Parasuraman (2006)

December 10: TERM PAPERS DUE

READINGS

Required Text

Wickens, C. D., & Holland, J. G. (2000). *Engineering Psychology and Human Performance.* Longman.

Additional Required Readings

For September 14:
Swets, J. A., Dawes, R., & Monahan, J. (2000). Better decisions through science. *Scientific American, October,* 82-87.

For October 12:
Kahneman, D. & Tversky, A. (1974). Judgment under uncertainty: Heuristics and biases. *Science, 185,* 1124-1131.

For November 2:
Parasuraman, R., Sheridan T., & Wickens, C. (2000). A model for types and levels of human interaction with automation. *IEEE Transactions on Systems, Man, and Cybernetics, 30*, 286-297.

For December 7:
Miller, C., & Parasuraman, R. (2006). Designing for flexible interaction between humans and automation: Delegation interfaces for supervisory control. *Human Factors,* in press.

Optional Readings

Degani, A. (2003). *Taming Hal. Designing Interfaces Beyond 2001*. New York: Palgrove Macmillan.
Matthews, G. et al. (2000). *Human performance: Cognition, Stress, and Individual Differences.* Hove, Sussex: Psychology Press.
Parasuraman, R., & Rizzo, M. (2006). Introduction to neuroergonomics. In R. Parasuraman, & M. Rizzo (Eds.) *Neuroergonomics: The Brain at Work.* (pp. 1-12). New York: Oxford University Press.
Vicente, K. (2003). *The Human Factor.* New York: Routledge.