Utah School of Computing

# *The "Human" Side of HCI: Human Factors Psychology and Assistive Technology*

Margaret Jelinek Lewis, PhD

## Presentation Overview

Three Parts

1. Overview of Human Factors Psychology
2. Primer in Cognitive Psychology
3. Introduction to Computer Access and Assistive Technology



## What is Human Factors?

- The application of psychological principles to the design of human-machine systems.
- Human factors professionals develop models of human performance that can aid designers of human-machine systems.



## What is Human Factors? 2

- Meister (1989): "The study of how humans accomplish work-related tasks in the context of human-machine system operation, and how behavioral and non-behavioral variables affect that accomplishment"

## What is Human Factors? 3

- Meister (1989):
  - "behavioral" refers to ***psychological*** constraints - how do humans process information?
  - "non-behavioral" refers to ***physical*** constraints - can a human physically work a control?

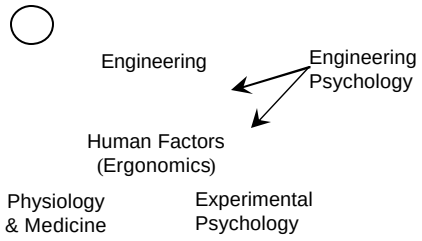


## What is Human Factors? 4

- Emphasis in Human Factors is on *design - **how** should a system be designed to accommodate a human operator?*



## Contributing Fields:






## How does Human Factors differ from Experimental Psychology? 1

- Experimental Psychology is the scientific study of mind, brain, and behavior
  - ***Why** do humans think and behave the way they do?*

## How does Human Factors differ from Experimental Psychology? 2

- Human factors is the study of human behavior in the context of technological systems
  - ***How*** *should we design a system to accommodate the way humans think and behave?*



## History of Human Factors 1

- WWI
  - Personnel Selection: psychometricians
- WWII and the genesis of Human Factors (or Engineering) Psychology
  - Personnel Selection continued to be emphasized "fit the man to the job"
  - Human Performance: experimental psychologists "fit the job to the man"



## History of Human Factors 2

- Post WWII: Formal Human Factors research laboratories established
  - 1945: Air Force establishes the Aero Medical Research Laboratory - "engineering psychology"
  - 1945: Navy establishes psychological research units



## History of Human Factors 3

- Post WWII: Formal Human Factors research laboratories established
  - 1951: US army establishes the Human Engineering Laboratory
  - Many military and civilian scientists return to universities and continue human factors research

## History of Human Factors 4

- Applications emphasized in 1950s –'70s
  - Military Systems
  - Civilian aviation and manned spacecraft
  - Transportation systems
  - Process control and nuclear power
  - Safety



## History of Human Factors 5

- Other app's emphasized since the mid-'70s
  - Human-computer interaction (HCI)
  - Virtual Environments
  - Medical Systems



## Why is Human Factors Important to Computer Science? 1

Human Factors psychology examines the capabilities of humans and how these constraints and abilities affect design.



## Why is Human Factors Important to Computer Science? 2

- Therefore, it is concerned with cognitive issues and research concerning human interpretation of stimuli and our abilities to deal with certain situations.
- The goal is to design systems with these capabilities and limitations in mind.

## Human Factors Applies Principles of Cognitive Psychology 1

- Cognitive issues that must be considered:
  - Memory (span, retrieval, storage capacity)
  - Visual and auditory capabilities/interpretations
  - Attention capacity (selective, focused, divided)



## Human Factors Applies Principles of Cognitive Psychology 2

- Cognitive issues that must be considered:
  - Judgment of tones, size, loudness, brightness
  - Interpretation of coding (traffic lights)



## Human Factors Applies Principles of Cognitive Psychology 3

- Cognitive issues that must be considered:
  - Response time to stimuli
  - Problem solving abilities
  - Decision making
  - Language comprehension
  - Disabilities
  - Cognitive load



## Applied Cognitive Psychology: Design Issues

- Screen/font color
- Menus
- Form fill-ins
- Special needs of users

## Assistive Technology

- A.T. is any device or piece of equipment that helps us as we go about our daily lives.
- In some cases, computers can *provide* (or be) assistive technology, in other cases, users need assistive technology *for* their computers to increase usability.



## Computer Access and Assistive Technology

- Goal is to fit the machine to the person (not vice versa!)
- Particularly relevant for people with disabilities – computers must be adapted for the use and needs of specific individuals



## Human Considerations in Software Design

Consider 5 different users:

1. A University of Utah student trying to do research for an HCI paper on the Web.
2. An adult on April 13 using tax preparation software (such as Turbo Tax) at home.



## Human Considerations in Software Design 2

Consider 5 different users:

3. A young woman with Cerebral Palsy who is typing a paper for a class.
4. A child playing a computer-video game.
5. An octogenarian grandparent sending email to faraway grandchildren.

## Rassmussen Classification of Human Error *

| *Performance Level* | *Error Type* |
|---|---|
| **Skilled based (SB)** | **Slips/Lapses** |
| **Rule based (RB)** | **RB Mistakes** |
| **Knowledge based (KB)** | **KB Mistakes** |

* James Reason, *Human Error*, Cambridge U Press, (1990) p96



## Rassmussen Classification of Human Error *

| *Dimension* | *SB Errors* | *RB Errors* | *KB Errors* |
|---|---|---|---|
| *Type of Activity* | Routine | Problem solving activities | Problem solving activities |
| *Focus of Attention* | On something other than task | To problem related issues | To problem related issues |
| *Control Mode* | Automatic processors (schemata) | Automatic processors (stored rule) | Limited conscious processes |



## Rassmussen Classification of Human Error *

| *Dimension* | *SB Errors* | *RB Errors* | *KB Errors* |
|---|---|---|---|
| *Predictability* | Predictable (actions) | Predictable (rules) | Variable |
| *Ratio Error: Opportunities* | Many errors; small percentage | Many errors; small % | Few;opportunity ratio high |
| *Situational Factors Effect* | Low to moderate | Low to moderate | Extrinsic factors dominate |



## Rassmussen Classification of Human Error *

| *Dimension* | *SB Errors* | *RB Errors* | *KB Errors* |
|---|---|---|---|
| *Ease of Detection* | Rapid and effective | Largely Predictable (rules) | Variable |
| *Relationship to Change* | Knowledge of change not invoked | When and how change is unknown | Changes not prepared for or anticipated |

## For More Information 1

Check out the WEB

- Human Factors and Ergonomics Society: www.hfes.org
- Computer-Human Interaction (SIGCHI): www.sigchi.org
- Bobby: www.cast.org/bobby



## For More Information 2

Check out the WEB

- Accessibility: www.w3.org/WAI (Web Accessibility Initiative)
- Kids & Computers: www.hcibib.org/kids
- Microsoft Accessibility: www.microsoft.com/enable



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*Human Factors…*

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