Design for Biomechanical and Anthropometric Fit

Moyen Mustaquim
moyen.mustaquim@im.uu.se

December 2012
Ergonomics

- **Ergonomics** is the study of designing equipment and devices that fit the human body, its movements, and its cognitive abilities.

The International Ergonomics Association defines ergonomics as follows:

- Ergonomics (or human factors) is the scientific discipline concerned with the understanding of interactions among humans and other elements of a system, and the profession that applies theory, principles, data and methods to design in order to optimize human well-being and overall system performance.

Moyen Mustaquim
Ergonomics Goal

Ergonomics is employed to fulfill the two goals of health and productivity.

• It is relevant in the design of such things as safe furniture and easy-to-use interfaces to machines and equipment.

• Proper ergonomic design is necessary to prevent repetitive strain injuries, which can develop over time and can lead to long-term disability.

Moyen Mustaquim
Fields of Ergonomics

Engineering psychology

- *Engineering psychology* is an interdisciplinary part of ergonomics and studies the relationships of people to machines, with the intent of improving such relationships.

Macroergonomics

- Macroergonomics is an approach to ergonomics that emphasizes a broad system view of design, examining organizational environments, culture, history, and work goals. It deals with the physical design of tools and the environment. It is the study of the society/technology interface and their consequences for relationships, processes, and institutions.

Neonatal ergonomics

- Neonatal ergonomics is the field that studies the newborn's development (premature, ill, low birth weight, or healthy newborn) in his or her environment, whether in a Neonatal Intensive Care Unit or at home, and in an incubator, bed or in Kangaroo Care. This field enhances the quality of life of the baby by using ergonomics principles and best practice by providing sound physical/musculoskeletal, physiological, neurological, and psychological/social/emotional development, and decreasing life threatening events that may be caused by poor habitat/environment, such as bradycardia/apnea of prematurity.

Moyen Mustaquim
Fields of Ergonomics

Seating ergonomics

• The best way to reduce pressure in the back is to be in a standing position. However, there are times when you need to sit. When sitting, the main part of the body weight is transferred to the seat. Some weight is also transferred to the floor, back rest, and armrests. Where the weight is transferred is the key to a good seat design. When the proper areas are not supported, sitting in a seat all day can put unwanted pressure on the back causing pain.
Ergonomics Classification

• Physical ergonomics: is concerned with human anatomical, and some of the anthropometric, physiological and bio mechanical characteristics as they relate to physical activity.

• Cognitive ergonomics: is concerned with mental processes, such as perception, memory, reasoning, and motor response, as they affect interactions among humans and other elements of a system. (Relevant topics include mental workload, decision-making, skilled performance, human-computer interaction, human reliability, work stress and training as these may relate to human-system and Human-Computer Interaction design.)

• Organizational ergonomics: is concerned with the optimization of socio technical systems, including their organizational structures, policies, and processes. (Relevant topics include communication, crew resource management, work design, design of working times, teamwork, participatory design, community ergonomics, cooperative work, new work programs, virtual organizations, telework, and quality management.)
Anthropometry

• refers to the measurement of the human individual. An early tool of physical anthropology, it has been used for identification, for the purposes of understanding human physical variation, in paleoanthropology and in various attempts to correlate physical with racial and psychological traits. **Craniometry** is a section of anthropometry that exclusively studies craniums.

• Anthropometric studies today are conducted to investigate the evolutionary significance of differences in body proportion between populations whose ancestors lived in different environments.
Anthropometry

• Anthropometric variables such as height and reach should be considered as independent of each other. Therefore the more variables that you are designing for, the smaller that population that will fit across all of those dimensions.

• Human bodies do not have fixed aspect ratios like screens do, but it seems a little more than coincidental that widescreen displays became popular in synch with the growth in population obesity.

• Providing multiple sized designs or adjustability are pragmatic solutions when good fit is important, but in most cases, a single, satisficing solution is required.

• Use anthropometric data as a starting point to build mock-ups or prototypes, then evaluate fit
Anthropometry

- Knowledge of ergonomic methods and techniques is becoming a valuable skill set for interaction designers due to the growing diversity of devices, users and contexts for interaction.
- Anthropometrics, the measure of the human body, is a fundamental area in ergonomics, and a starting point for understanding how to design systems that fit people.
- Among anthropometric approaches, designing for a broad range (5th to 95th percentile) is often the most practical and accommodating.

Moyen Mustaquim
Driving Factors

• The rapid proliferation of touch screen and other gestural interfaces which combine "direct" physical control with digital interface design. If you want to design for a finger, you have to know how a finger works.

• The growth of ubiquitous computing leading to an increased range of scale and form factor in devices that contain interfaces. As a result, people are interacting with interfaces in range of positions and contexts that go beyond simply standing or sitting in front of a screen.

• Computing power and bandwidth across such devices now supports more complex, involved tasks such as data entry, long duration reading and gaming, all of which can lead to risks for repetitive motion injuries, or at least discomfort. Having a knowledge of the types of interactions that can cause such injuries, and how to design around them, is essential.

• An ever increasingly diverse range of end-users are gaining access to interactive devices, across age, and physical characteristics. For example, the One Laptop Per Child campaign has produced a global, kid-sized laptop. In home health care, a market of predominately elderly users, more devices contain embedded interfaces.

• Last, but not least - interest. Several of the factors described above are driving many interaction designers to explore and study the world of physical product design.

Moyen Mustaquim
Dementia

- Everything should be done simply for a person with dementia.
- The present is the only thing that exits, not a minute ago or then. A designer needs to bear in mind the consequences of this.
- Sensory impressions are of far more importance that ever before. Smell, vision, hearing, touching – all play an important role as does music and rhythm. But it has to be the elderly person’s rhythms and music, not that of younger staff members.
- The older person becomes like the child she once was – rather than like a child in general. Personality has not disappeared, though, even if many memories have.
- Contact can be established with long-term memory, but for that to happen often requires that you blaze a new trail. Clear odors and pictures can be effective.
- Enable the establishment of attachment whenever possible. But not with fragile china figurines and other cherished items from the past that the person is simply unable to handle.
- Utilize colors much more that they are now. (Example: Use a bright red for attention getting.)
- Avoid all choices: A person with dementia is unable to choose.
- Make use of imitation: In eating situations, for example, have someone else eating at the same time. And, of course, one dish at a time, no questions about which dish the person with dementia wants. Keep things clear and simple.
- Make use of conditioning. It is easier to understand that it is time for lunch if you can smell the food from the kitchen than to understand that lunch is served at 12.30.

Moyen Mustaquim
Design?

• Maintain rhythm and balance
• For your own doing and learning
• For communication
• For telecommunication
• For planning
• For memory function
• For a change as little as possible

Moyen Mustaquim
What would be future design focus in terms of ergonomics and inclusive design by the power of biomedical engineering? What should be the concern and focus for the end users according to you?

‘Best way to predict the future is to explore it’. Argue this statement in your own words while explaining universal design and its future.