Ergonomics, human factors engineering, and Gerontechnology: From 'accommodation' to robust design

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R.D. Ellis, Ergonomics, human factors engineering, and Gerontechnology: From 'accommodation' to robust design, Gerontechnology 2005; 4(2):61-62. Human factors engineering, also known as ergonomics, is a broad field focused on the fit between people, tools, tasks, and environments. Traditional approaches to solving ergonomics problems have focused on 'normal' populations. There are several reasons, including diversity of the older age group, why this approach is flawed when dealing with older adults. Robust engineering techniques from the broader field of engineering hold promise for coming up with design solutions that will benefit older and younger people alike.

Keywords: human factors, ergonomics, robust design

A major contributor to the gerontechnology research and development movement comes from the field of ergonomics and human factors engineering (E/HFE). E/HFE is a fairly young field of inquiry, with its roots as a discipline firmly planted in the middle of the last century, although its earliest antecedents can be traced into the 18th century. E/HFE is a broad interdisciplinary field that overlaps with engineering, behavioral sciences and life sciences. At its heart, the discipline is concerned with the fit between people, and their tools, tasks and environments[1]. A natural question in the field is to ask what proportion of a population could perform a given task, use a given tool, or find a given environment comfortable and usable. Useful design constructs such as design 'accommodation' have been developed, for example, to quantify the number of workers that would be able to perform a task from a 'normal' population.

Often, this leaves older adults in the margins of E/HFE research as a 'special population'[2]. Typical treatments of aging in general E/HFE texts start with a laundry list of 'normal' age changes and potential additional deleterious effects from age-related morbidity and chronic impairment. This is undoubtedly instructive for ergonomists who are completely unfamiliar with the older population. However, it does not encourage designers to take older adults into consideration in the first place. Special studies on ergonomic interventions for older adults are well-intended and useful, but this leaves the issue somebody else's problem. The entire E/HFE community should do the right thing by conducting inclusive research that takes older adults into consideration as part of the 'normal' population to the greatest extent possible. Given the fact that the older a segment of the population is, the more diverse it will be in terms of capabilities and limitations, this will be a difficult task methodologically speaking. Screening tools can quickly sort out simple differences which would clearly separate capability based

on factors other than age, such as the presence and severity of arthritis with regard to the design of a hand control.

E/HFE research focused on older adults is being influenced from several directions. It is becoming increasingly common to see E/HFE research use constructs from Gerontology. For example, blending traditional ergonomic methods such as task analysis with gerontological principles such as instrumental activities of daily living is becoming more common[3,4]. Developmental theories such as 'selective optimization with compensation'[5] may help us better understand phenomenon like self-imposed changes and limitations in driving patterns among some older drivers. Blending these approaches will serve to increase the likelihood that these efforts will have a positive impact on older adults.

In the near future, we should see more contribution from the engineering design community. Techniques that have proven useful in engineering in general, and are making their way into the E/HFE community include Robust Design (also known as the Taguchi Method[6]). In a typical empirical inquiry focused on an issue of ergonomics and aging, one might see a standard experimental design with ergonomic design factors used as independent variables and age employed as a quasi-experimental variable. Results are then scrutinized for interaction effects that would indicate that one particular treatment condition of the ergonomic design factor(s) was disproportionately better or worse for older adults. In contrast, the Taguchi method begins by identifying things more under the control of the designer (such as the ergonomic factors) and terms them 'control factors.' Things that are under less control of the designer (such as the age of the user) are termed noise factors, and the experiment is conducted in order to determine the best overall combination of control factors (the most robust design), given the variation in the noise factors. While there are drawbacks to the use of Taguchi methods, there may be significant advantages to their use in the field of gerontechnology.

As the field of gerontechnology continues to emerge and mature, the cross-fertilization of ideas and approaches will no doubt continue with the broader engineering and E/HFE community. As demographic pressures mount and the needs of older adults come more to the fore, it will become even more critical that professionals in gerontechnology and E/HFE look for new ways to include older adults, and be sensitive to their needs without stigmatizing them.

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