

COMMENTARY

Reduced visual acuity in elderly people: the role of ergonomics and gerontechnology

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Summary

Gerontology is the scientific study of the ageing process and special problems of aged people. Ergonomics is an applied science for optimizing performance and productivity and reducing the risks of injury, discomfort and illness. Gerontechnology is concerned with fundamental and applied research on the complex interaction of elderly people with technological products and the built environment. It has the potential to improve the capability of people confronted by the challenges of ageing. We suggest that gerontechnology may have a particular role in relation to the reduction of visual acuity, and can improve the comfort and safety of older people.

Keywords: ageing, ergonomics, gerontechnology, technology, visual acuity

Introduction

Some of the difficulties encountered by older people are caused by environmental problems. Technology has an integral role in improving the social and physical environment. Ergonomics is the science concerned with design of liveable spaces, equipment, machines and other environmental features. It aims to match the capabilities and limitations of people, thereby enhancing opportunities for optimizing performance and reducing the risks of injury, illness and discomfort [1–4]. As manufacturing and service industries throughout the world attempt to improve performance through quality initiatives, they are implementing ergonomic principles. Quality may be defined as meeting or exceeding customer expectations (fitness for use) or conforming to specifications (manufacturing quality) [5].

Gerontechnology is the discipline concerned with fundamental and applied research involving the complex interaction of elderly people with products and

technical or built environments [6, 7]. It involves the study of technology and ageing to produce a better living environment and medical care setting for ageing people.

Gerontechnology can compensate for declining capacities in old age. Products and techniques can mitigate the sensory and perceptual losses and compensate for loss of strength and mobility [6, 7]. Another goal is to provide new opportunities for work, leisure, learning and social activities. In this respect, gerontechnology can also provide technical support to help caregivers and physicians care for elderly patients. Medical units for older people may be improved by the ergonomic approach [8–10]. Moreover, the enhancement of social interaction through communication technology (development of user-friendly computer systems for games, artistic and creative activities and learning through multimedia technology) is potentially important.

By using available technology to minimize morbidity and extend functional autonomy, gerontechnology can

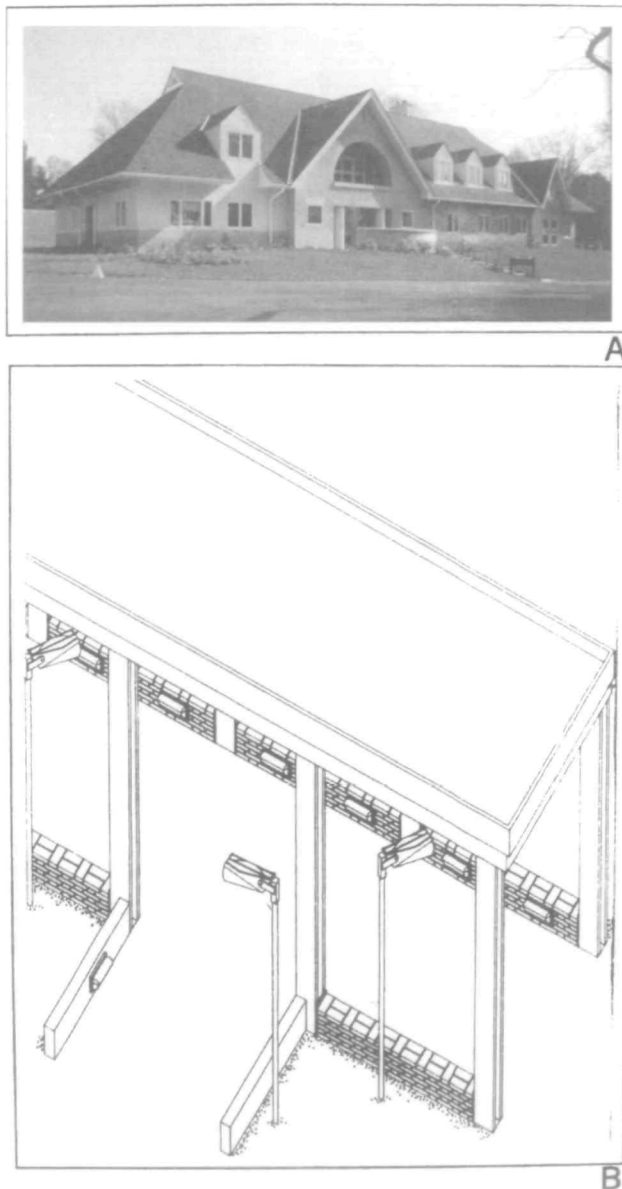


Figure 1. (a) An outpatient department for elderly and disabled patients. The roof design emphasizes the image of a large and friendly house. The exterior wall finish is cement stucco in two colours and textures. The building receives natural light and this emphasizes a relationship to the terraced exterior. (Design by A. Zlotnicki and C. Van Sant, Philadelphia, PA, USA.) (b) An outdoor pathway equipped with a downwards-directed lighting system. A system of several low-level down-lights guarantees optimal illumination of the floor.

increase independence. Examples of this include improved design of lighting, mobility aids and devices to improve the ability to carry out activities of daily life [11, 12].

Impairment of vision in old people is associated with poor quality of life [13, 14] and mortality [15]. The aim of this brief commentary is to focus on the risks of

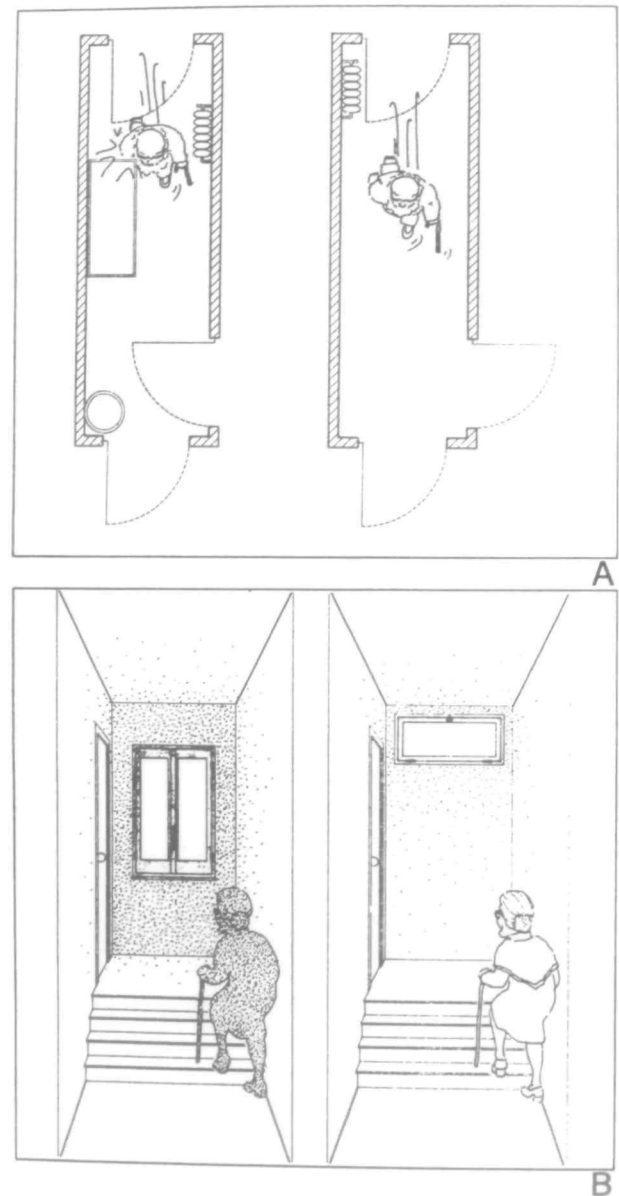


Figure 2. (a) Improved organization of furniture and equipment in a corridor (≥ 80 cm wide). The door at the end no longer opens into the passageway. (b) The correct position of the window (high rather than low) to decrease glare.

reduced visual acuity in elderly people and see how they might be reduced by altering the environment and improving technological design.

Visual acuity and ageing

Abnormalities in visual perception, defined as the ability to perceive the orientation of the self and structures within the environment, might predispose elderly people to falls and injuries [16]. Reduced visual acuity in old age is mostly due to cataract, macular

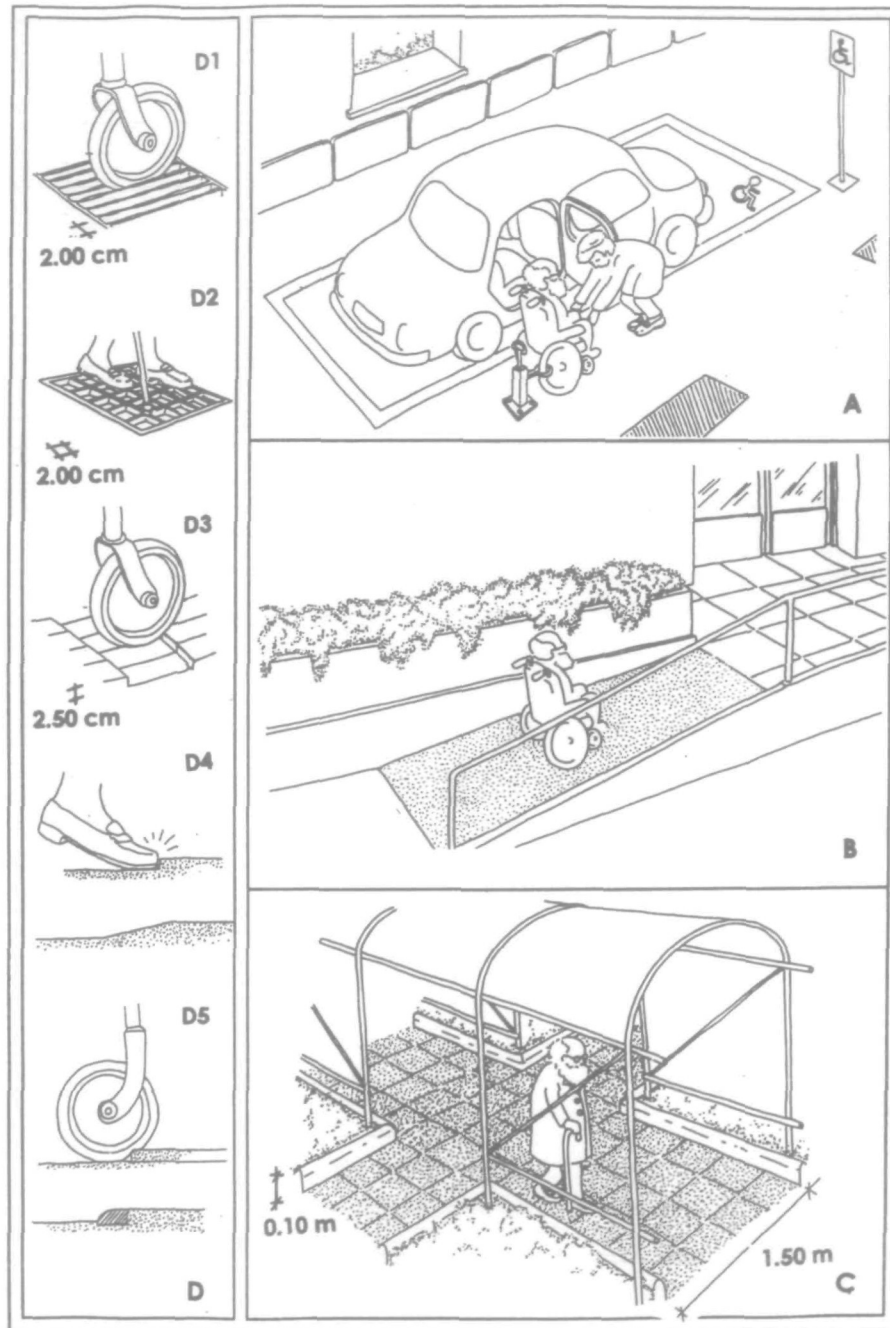


Figure 3. (a) A disabled patient brought to hospital by car. The building is fitted with a covered approach for cars, to protect patients from wind and rain. Parking areas are located near the entrance and equipped with springing pincers to block the wheelchairs. (b) Surfaces are of a gentle gradient and of different colours to avoid the risk of fatigue and falls. (c) An outdoor pathway, large enough to allow the passage of two people, is covered, to protect from wind and rain in winter and from the sun in summer. Such pathways should also be equipped with barriers to separate the walking area from the grass. These should be of a different colour to the floor and the grass, to guide patients with a reduced vision. Barriers should be at least 10 cm high to be effective. (d) Recommendations for floor surfaces. (d1 and d2) Grids should not be too large for patients using wheelchairs or canes. (d3-d5) When floor reliefs are higher than 2.5 cm they are an obstacle for wheelchairs and for walkers: less abrupt changes and rounded edges make them less dangerous for disabled and older people.

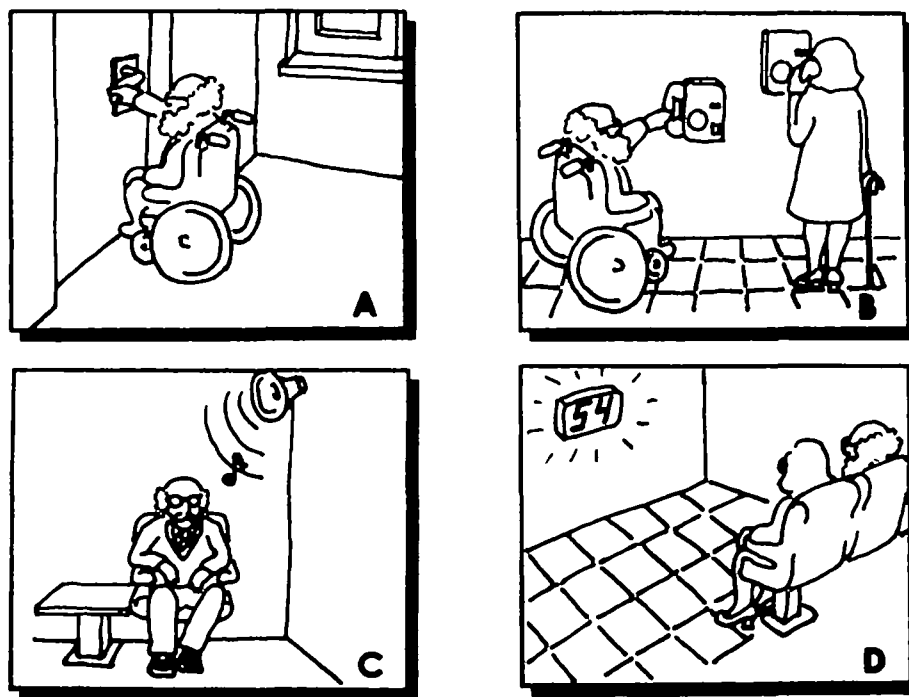


Figure 4. (a) A larger handle is clearly identifiable to patients with reduced visual acuity. (b) Optimum position of the telephone for these patients. (c and d) Acoustic and visual devices to help patients with reduced hearing also.

degeneration and chronic glaucoma. Accidental falls of patients in a geriatric care hospital have been videotaped [17] and analysis revealed that poor lighting was a factor in 40% of the falls recorded.

Gerontechnology and building

One of the first steps in gerontechnology is to retrofit existing buildings. Furthermore, the architectural design of a place for elderly people with reduced vision attend as outpatients could emphasize the image of a friendly house (Figure 1a) rather than a conventional clinical building.

Recommendations for reducing risks

Environmental

Environmental risk factors for older people with reduced visual acuity, dark adaptation and perception include: (i) insufficient natural or artificial lighting; (ii) dazzle; (iii) difference in lighting intensity between outside and inside of buildings; (iv) difference in lighting between corridors and rooms; and (v) insufficient illumination of small objects, such as door-handles. Extra lighting may be appropriate for some disabled patients (Figure 1b), but improving illumination may not merely be a matter of installing more lights: the way in which the lighting is arranged is also important. The source of natural light may be critical for decreasing the glare phenomenon (Figure 2b). The

reduction of environmental risks may involve other design interventions: Figure 2a illustrates how careful organization of equipment in a limited space may help reduce accidents in elderly people with impaired vision.

Recommendations include: illumination of floor of ≥ 300 lux; illumination of work surface of 500–800 lux; absence of glare and shadows; locating windows on the sides or ≥ 1.70 m in height; providing for a sun shading system in eastern or westerly windows; reducing the different level of illumination between inside and outside; using uniform lighting between corridors and rooms; and correct location of direct light.

Technological

The risks of inappropriate technology include: (i) floors (loose mats, slippery floors, particularly those adjacent to steep slopes; difference in height between a doorstep and an entrance; uneven floors; reliefs in the floor or gradients); (ii) walls (surface material; elements, such as pillars or short walls, isolated in construction); (iii) door (unmarked glass; handle not identifiable; door which does not open completely due to obstacles, such as radiators or furniture that prevent 90° rotation; doors of the same colour as the walls); and (iv) furniture (low-level furniture; furniture of the same colour as the wall; handles that are not identifiable; sharp corners).

Figures 3 and 4 give some examples of interactions between ageing and technology. Figure 3 depicts the

Table 1. Recommendations for improving technological design of areas used by older people

Area	Recommendation
Floor	Doormat inset and with shallow pile Doorstep height <2/2.5 cm Height and width of floor component joints <2 mm No relief patterns
Wall	No glare surfaces: glare index limit <10
Doors/windows	Doors made of opaque materials Handles obvious and of different colour to the door/window Lighting that increases colour contrast between doors and surroundings
Furniture/equipment	No sharp corners No jutting or recessed bases of pieces of furniture Handles obvious and of a different colour
Lighting	
Direct ^a	Ceiling-mounted fluorescent lamp or parabolic louvre (high or silk gloss)
Indirect	Floor-standing high pressure lamp shining upwards to the ceiling or diffuse reflector and covered lamp shining downwards in the room
Direct/indirect	Units with parabolic louvre (silk gloss) mounted with pendulums below the ceiling, floor-standing fluorescent lamps linked to table lamps or diffuse reflector and covered lamp shining downwards in the room in combination with table lamps

^aShining downwards in the room.

complex issues of accessibility for disabled patients with reduced visual acuity. The degree of disability classifies several classes of patients: from a slight reduction of visual acuity to complete loss of visual function [18]. Figure 4 suggests some ways to compensate for sensory and perceptual losses. Finally, a careful assessment of design has several potential applications for reducing risks of poor technological design (Table 1).

Conclusions

We have focused on the role of gerontechnology in older patients with reduced visual acuity. We suggest that gerontechnology may improve the quality of life in these people. Incorporating principles of ergonomic design for older adults makes sense, but at present the design industry does not pay adequate attention to issues unique to the older population. The ergonomic approach should be used to improve comfort and safety of older people.

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