DESIGN RESOURCES

DR-13 Vision Aspects of Universal Design

Center for Inclusive Design and Environmental Access

Vision Aspects of Universal Design

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Issue and Its Importance to Universal Design and to Stakeholders

Universal Design is a process that seeks to create products and environments that can be used equally effectively by everyone, including people with significant levels of disablement. Creating environments that are more "universal" requires a special understanding of the performance characteristics of those who are potentially marginalized by less inclusive design strategies. Designers could begin to provide more inclusive solutions for these marginalized groups by anticipating their common functional impairments. A good example of a group that has often been overlooked by designers is people who are frail and elderly. UD design strategies have focused on this frail elderly population with respect to their use of mobility devices such as canes, walkers, or wheelchairs. There have been significant developments in the area of UD for physical disabilities. Less energy has been devoted to relevant aspects of sensory impairments that are also common within this target population.

Some measurable degree of vision loss is an inevitable consequence of aging. In addition, many diseases that cause greater levels of vision loss become more prevalent as people get older. With the aging of the baby boomer generation, the number of people suffering from untreatable vision loss is steadily increasing. This looming cohort of older adults with impaired vision poses a significant challenge for UD adherents. In order to respond to this challenge, UD designers must understand the common functional consequences of vision loss in the elderly (Haegerstrom-Portnoy, 2005). Visual acuity, coarse stereopsis, colour discrimination, contrast sensitivity, and visual fields diminish as people get older. Older people also exhibit heightened susceptibility to adverse viewing conditions such as the presence of competing light sources within the field of view (disability glare), divided attention, or when the overall illumination is too bright (discomfort glare), too variable, or too dim. These visual performance deficits are correlated with functional ability deficits in older people (Haegerstrom-Portnoy, 2005) and conscientious UD processes must accommodate for them (West et al., 2002). Even still, the true nature of the problem may be significantly understated because the documented impairment data were derived under viewing conditions that are significantly different from those in real life when people are negotiating built environments.

Key Terms

<u>Visual acuity:</u> a person`s ability to resolve fine details; common visual acuity testing utilizes paper or projected charts composed of systematic rows of letters that become smaller and smaller and hence more difficult to see; a person`s visual acuity identifies the smallest letter size that can be seen by the individual being tested.
<u>Coarse stereopsis:</u> a person`s ability to recognize three-dimensional depth, to judge relative distances, and to appreciate the relative distance between two objects located in front of the person.
<u>Colour discrimination:</u> a person`s ability to distinguish between objects or lights having different wavelength compositions (colours). Color vision is commonly tested using plates consisting of an

organized pattern of dots against a neutral background of another colour. The pattern becomes indistinguishable when a colour vision deficit is present. The respective colours are selected to differentiate between different types of colour vision defects and quantify the level of the colour vision deficit from mild to profound.

Contrast sensitivity: a person`s ability to visually distinguish an object that is poorly contrasted with its visual surroundings. Most tests for contrast sensitivity measure a person`s ability to identify low contrast letters, lines, or pictures.

Visual fields: In general terms, a visual field is a clinical description of a person's field of view; the angular amount of the world that is visible to a person when looking straight ahead without any eye or head movements. A normal binocular visual field is over 190 degrees horizontally (extending from the left periphery to the right periphery) and about 140 degrees vertically (from the lowermost periphery to the uppermost periphery).

Disability glare: Glare describes any visual interference caused by sources of bright light within a person`s field of view. Disability glare is when this glare results in a reduced ability to perform seeing tasks.

Discomfort glare: any glare that causes discomfort for the individual (may or may not occur in tandem with disability glare).

Contralight: literally means against the light; a unique form of glare may occur when a person is viewing an object that is located against a bright background such as a window.

Design Guidelines

An important consideration with respect to how we see the built environment is that most interactions involve dynamic seeing activities; the individual's eyes, head, and body are invariably in motion. This becomes relevant when one considers that most descriptions of visual performance describe visual capabilities with the eyes virtually immobilized straight ahead in the primary gaze position. The habitual directionality of gaze for older people navigating within a built environment is primarily directed downward relative to the horizon (Hill &Kroemer, 1986). Another complication is that many seeing activities are significantly affected by any hostile viewing conditions (such as glare, excessive brightness, and/or dim lighting conditions) that may exist in built environments. The situation is further compounded by the fact that people are often engaged in activities that require divided attention (such as listening, reading, conversing, or mental calculations). Research has shown that divided attention significantly diminishes the lateral dimensions of the visual field (Brabyn et al., 2001) and limits an individual's capacity to discern detailed content within this already-diminished visual field even when compensatory eye and head movements are possible. Mindful of these vision impairment factors that affect the functional seeing performance of people who are frail and elderly, the following guidelines will help designers to make more inclusive decisions:

- All surfaces should be evaluated to ascertain whether, by virtue of their location and/or surface finish, they add unnecessarily to glare and contralight conditions (matte or texture finishes work best).
- All window and doors should be glare controlled and placed to minimize detrimental effects of glare and contralight seeing conditions on the visibility of obstacles or potentially hazardous features in the built environment.
- The effects of aging and age-related ocular disease on color vision perception may significantly diminish the visual effectiveness of certain color combinations.

- Make critical elements larger and ensure that they have high luminance contrast with their surroundings.
- Contrast differentiations provide useful markers for stairs, floor boundaries, and any obstacles to be navigated.
- Provide task lighting that can be easily adjusted to meet individual needs and task demands of the space user (task lighting may be required to augment ambient light for many task activities).
- Pay attention to potentially hazardous conditions in high attention task areas such as the kitchen and the bathroom. In the kitchen, for example, attention may be focused on stove or cooking activities making users' vulnerable to stove hazards and/or head collisions with cupboards due to visual inattention during multitasking. Front controls on the stove and prudent cupboard layout might conceivably mitigate these risks.

Additional research is required to investigate the functional impacts (perceived utility, effectiveness, and attractiveness) of low vision accommodations being incorporated into the design of built environments for a variety of potential users (elderly, visually impaired, and visually unimpaired).

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References
Brabyn J, Schneck M, Haegerstrom-Portnoy G, Lott L (2001)The Smith-Kettlewell Institute (SKI) longitudinal study of vision function and its impact among the elderly: an overview. Optometry and Vision Science 78:264–269.

Haegerstrom-Portnoy G (2005) The Glenn A. Fry Award Lecture 2003: Vision in elders—summary of findings of the SKI study, Optometry and Vision Science. 82:87–93.

Hill SG and Kroemer KHE (1986) Preferred declination and the line of sight. Human Factors 28 (2):127-134.

West CG, Gildengorin G, Haegerstrom-Portnoy G, Schneck M, Lott L. Brabyn J, (2002) Is Vision Function Related to Physical Functional Ability in Older Adults? Journal of the American Geriatrics Society 50(1):136 – 145.

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