Adaptations of the Physical Environment to Compensate for Sensory Changes

INTRODUCTION

The physical environment, as it relates to the dependencies of older adults, remains one of the most overlooked areas in environmental design. In order to move beyond this status quo, persons responsible for planning that environment must develop a new understanding of ways in which their influence can improve the older adult's physical and mental functioning. This section deals with age-related changes in vision, hearing, taste, smell, touch and kinesthetic systems, and provides recommendations for environmental adaptation and modifications which may compensate for the changes in each of these systems.

As people age, certain sensory changes cause them to perceive and respond to the physical environment in different ways: a person may walk more slowly, move more deliberately, hold reading material farther from the eyes, or strain to distinguish a voice in a crowd. As more and more limitations in functioning are experienced, the person becomes more dependent on that environment for support. Indeed, "as strength fails and as the sensory organs incur deprivations, the individual experiencing these losses reaches out to both the general social environment and the physical environment in order to continue functioning (Koncelik, 1976, pg. 15)."

Sensory changes not only increase as people grow older but are usually compounded by the simultaneous occurrence of changes in several sensory systems. However, the age of onset and the rate of decline for these functions differ markedly among and within the various sensory systems (Corso, 1971).

Age-related changes occur gradually, and most people continue to function adequately at home or in familiar surroundings. Yet, for a growing number of persons, sensory changes are so altered that
functioning in the environment is difficult at best and may even be impossible. The impact sensory changes have on the person with confusion must be considered when planning environments for those individuals with dementia. The reduced sensory acuity that accompanies age produces sensory deprivation.

When an older person does not respond to "normal" amounts of stimulation, increased stimulus is required. However, too many changes may result in sensory distortion. With impaired hearing, for instance, usually the higher ranges of tones are affected. But, when volume is increased to hear these tones, even fuzzily, the volume may be too loud in the low ranges where hearing is relatively normal. Thus deprivation, distortion, and overload may exist simultaneously for the older person (Wolanin & Phillips, 1981).

Although sensory alteration may arise in any setting, the institutionalized elderly are particularly vulnerable. In addition to experiencing greater impairment, these adults also face increased exposure to situations offering little variety or stimulation.

Sensory deprivation research suggests "that most impairments are confined to the 'visual modality' and include a general decrease in the efficiency of perception of stimuli (Schultz, 1965, pg. 97)." Parent (1978), has summarized the effects of sensory deprivation to include: loss of the ability to concentrate, disorientation and reported hallucinations, and delusions. Illusions are also common. In early studies done in the Hebb's Laboratory at McGill University, lack of sensory stimulation created significant changes in the individuals under study. Bexton's early research (1954) brought to light the dependency individuals have upon the environment.

The recent increase in the development of special long-term care units designed for those with senile dementia, requires that we attempt to perceive the environment from the perspective of residents. Since the person with dementia will also be experiencing the normal age-related sensory changes, adapting the physical environment to meet the needs of the confused person becomes even more critical. New findings concerning the behavior of the person with dementia must be applied to the less structured institutional situations, as well as the more conventional long-term care unit.

The environment should be constructed so that it enhances the functioning of all persons with sensory deficits. Designing and dec-
orating should provide "redundant" cuing. The combined input of hearing the sound of kitchen activities, smelling the aroma of food cooking, and seeing and touching the table and dishes tells us, through redundant cuing, "This is the dining room" (Pastalan, 1973). Provision of such multiple input allows older persons to compensate for losses by using the best combination of remaining sensitivities rather than being dependent on only one sense.

Those who provide care to older adults must be aware however of the possible negative effects of redundant cuing. For example, if a confused person is seated at the table long before meal time, the redundant input implies eating and the person may react by simply becoming more agitated.

Landmarks or prominent features marking a particular locality can help an older person be oriented in a space. Just as certain buildings, and monuments serve as focal points in a city, picture groupings or special textured objects or surfaces can be used as landmarks in an older person's environment. These landmarks give cues concerning where to sit, to turn or to stop. Those who work with older adults should help them understand the cues by explaining their purpose and by using the cues to orient them. For example: One might say to the person in the nursing home, "This is your room, Mr. Smith, here by the large picture of red flowers." For the person living at home the verbal cue might be, "Ellen, we're back at your house, here's your mailbox with the red cardinal on it."

Lawton (1980) has classified environments on the basis of demand character. Some environments make greater behavioral demands on people than others. This dimension is called "environmental press," following the terminology of psychologist Henry Murray. It specifies that those with higher levels of competence can adapt to a wider range of environmental press with greater likelihood of experiencing favorable adaptive outcomes.

The environment has the greatest effect on the person with the least capability. Although slight increases in environmental press may result in maladaptive behavior, other small changes such as increased lighting, reduced noise, or added texture may cause meaningful improvement in behavior (Kiernat, 1985). It is also thought that human interaction with the environment and its objects has a major role in eliciting intelligent behavior. Many researchers
contend that coping with appropriate environmental complexity contributes to mental function.

Designing an environment with these changes in mind creates a supportive environment that makes it possible for more individuals to function at their maximum capabilities. In addition, most adaptations will facilitate functioning for formal and informal caregivers as well.

**VISUAL ADAPTATION**

For the older person with visual problems, the environment needs to be more structured and predictable, as well as visually richer (Wolanin & Phillips, 1981). Snyder et al. (1976), in a study of 295 extended care residents over 65 years of age, found that 24 percent were legally blind (20/200 with correction) and 35 percent had low visual acuity (20/70 to 20/100 with correction). Since many of these conditions were unknown prior to the study, many corrective measures were consequently initiated. Visual screening should be done initially as well as periodically to determine any resulting change in the older person's level of need. Hiatt (1980) has reported a thorough visual screening procedure that can be administered in the nursing home as well as other settings. This procedure includes testing for: near vision, far vision, mobility, fear and security, sensitivities and special implications of specific eye conditions. A practical guide for caring for the visually impaired older person is available from any local Society for the Blind.

As an individual ages, structural changes occur in the eyes that affect vision. Some of these changes involve the lens, which shows a gradual increase of tissue at the center. In the internal structures of the eyeball, small opacities and vascularites develop. These alterations are further complicated by changes in the surrounding eye muscles and decreased elasticity of the lens. These changes cause a scattering of light that blurs the retinal image (Corso, 1971), decreasing an individual's ability to see objects clearly and increasing the susceptibility to glare.
Visual Aids

Large contrasting lettering on signs and on written directions will facilitate vision for the person with acuity problems. Letters for signs should be a minimum of 5/8 inch in height and recessed or raised 1/32 inch for readability through touch (Bowersox, 1979). Lettering on signs also should contrast with the background (USAF, 1984). Large white or light colored letters, on a black or dark colored background will help older adults distinguish those letters from the surrounding background (Reznikoff, 1979). In the institutional setting, any type of name tag should also have large lettering, since typed lettering is too small for the older adult to read easily. A large-print calendar in a corridor can function both as landmark and an orienting aid. Clock faces with large light numbers on dark non-reflectant background should be located at the older person’s level.

The ability of the eye to differentiate detail is regulated by the process of accommodation and is dependent on the elasticity of the eye. Presbyopia, an age-related difficulty of accommodation, is a loss of the lens’s elasticity and thus the ability of the ciliary muscle to affect the curvature of the lens (Corso, 1971). This leads to decreased focusing on the detail of objects close at hand or at varied distances. For example, the older person who is playing cards will require more time than a younger person to shift the focus of vision from cards held in the hand to cards placed in the middle of the table.

In the initial stages of presbyopia, corrective lenses for near vision will rectify the difficulty of reading fine print close at hand. But correction may not be possible in later stages. At that point, books and periodicals with larger print and greater intensity, and contrast offer the older person the most benefit. Low vision aids such as magnifying glasses, preferably lighted, should be made available.

In a case study (Kornzweig, 1976) done at the Jewish-Home and Hospital for the Aged in New York, to determine if low-vision aids would be used by a group of visually impaired elderly, the following results were noted: Of the 83 residents examined initially, 62 were helped, to a greater or lesser degree by using the aids. Some of
the low-vision aids utilized included: large-print reading material, playing cards, bingo cards, and telephone dials.

Many items useful to low-vision persons are available through the American Foundation for the Blind (Cristarella, 1976). These devises include specially adapted watches and clocks. The partially sighted can also benefit from self-care techniques used by the blind. One such technique involves leaving in place commonly used items and arranging food and utensils in the same places for every meal.

**Lighting**

As the lens of the eye becomes less transparent and thickens, there is an increase in the amount of light required for a person to be able to see (Corso, 1971). Pastalan (1976) developed an empathic model that determined that a person of 80 years of age needs approximately three times more light to read than the person 15-20 years of age. As the transparency of the lens decreases and becomes more opaque, a cataract forms. By the time a person reaches 70 years of age, some evidence of cataract formation is the rule, rather than the exception (Colavita, 1978). The amount of light that reaches the retina of the eye is also reduced by the size of the pupil, which becomes smaller as the individual ages. Only about one third of the light that arrives at the retina of a 20-year-old falls on the retina of a 60-year-old (Corso, 1971). In addition, the ability to function in low light also decreases.

Reading and close work can be aided by increased illumination with task lighting, such as floor or table lamps with three-way bulbs. These allow better direction and level of lighting than conventional overhead fixtures (Bowersox, 1978). However, bulbs should not be exposed or installed directly in the older person’s line of vision since this creates direct glare.

Glare is a painful overload problem caused by too much illumination. Sensitivity to glare is caused by the opacity of the lens, as well as changes within the eyeball. Glare problems may develop from both a direct or indirect source. Direct glare occurs when light reaches the eye directly from its source. Indirect glare arises when the light reflects into the eye rebounding off another surface ( Birren, 1977).
Examples of such glare would include: Sunlight reflecting off a highly polished floor or stainless steel appliances, walkers, plastic-covered furniture, and waxed floors. Even dishes and silverware can reflect an uncomfortable level of light (Wolanin, 1981; Hiatt, 1979; Bowersox, 1978; Koncelik, 1976).

To reduce glare, avoid using glossy paint and shiny laminated plastic table tops. Windows may be covered with glare-reducing film, tinted mylar shades, mini-blinds or pleated polyester window shades. If the older adult suffers from incontinence, velour-like plastics or polyester upholstery using a vapor barrier can be used to decrease odors. This upholstery is installed with velcro and can be laundered in a clothes washer and line dried. This special fabric provides the texture and warmth of upholstery while still addressing the problems of maintenance.

When preparing publicity for seniors use the dull side of poster board to make signs and posters. Lobby directions and other glass-covered surfaces should have non-glare glass. Light reflected from structures or surfaces outside a window, water from a pond or lake, a white wall, can also cause glare.

Outdoor seating areas should be provided with sun screens, such as gazebos, wood trellises and fences. Roof overhangs, awnings, or building recesses also limit direct sunlight penetration. To reduce glare, consideration should be given to the location and types of trees used to shade courtyards and major glass areas. Older persons select glare-free areas where they can sit where people are likely to pass (Regnier & Pynoos, 1987).

Wall-mounted valance or cove lighting that conceals the source of light, and then spreads it indirectly upon the ceiling and down on the floor is recommended to eliminate glare. Better lighting will make it easier for older persons to recognize faces and improve communications. A study by Snyder (1978), showed that increased accidents in a nursing home seemed to be directly related to energy conservationists who turned out every other light in the hall, causing the contrast between bright and shadowed areas of the hallways to appear as steps, particularly to people with perceptual difficulties.

Fluorescent fixtures can reduce glare, but they must be selected carefully and ballasts checked regularly to be sure flickering is min-
imized (Bowersox, 1978). "Fluorescent light flickers which eludes many younger persons is quite evident to older people, causing tearing, headaches and general unattentiveness. Exposed lamp fixtures and improperly functioning ballasts may be causes" (Hiatt, 1979, pg. 8).

Fluorescent lighting should be combined with incandescent lighting in areas where extensive lighting is needed, e.g., bathrooms, reading areas, and so on. Whenever fluorescent light sources are used, choose warm-white deluxe or prime color tubes. Paraboloid patterned fixture covers on fluorescent lights, which are made of anodized aluminum and are often used in libraries, provide better light distribution and eliminate glare.

Fluorescent lighting has been eliminated from some long-term care units designed for terminal patients because of the flickering that can occur (Peppard, 1984).

Glare has other effects. Snyder (1978) reports that the attention span may be increased when reflection is reduced. Furthermore, bright lights and glare may distract older persons, especially those who have difficulty concentrating.

In some states rules and regulations for long-term care facilities defining the interior design, run counter to what researchers have discovered about the aging process. Many states, for example, require placing ceiling lights in the middle of every resident room. Such a situation creates direct glare for the person who is lying down, and residents who are sitting express a preference for focused task lighting such as table and desk lamps. Translucent wall or post fixtures, placed at eye level cause direct glare and should not be used.

Sight recovery for the older person is delayed when moving from a light area to a dark or darker area. Moving into a much lighter area also creates problems. For an older person, turning on a light in a dark room can produce the same effect that one experiences when a flashbulb flashes (Hatton, 1977). When older persons must come from a light area to a darker area, such as into a foyer or into their own room from a hall, no furniture or other objects should be placed by the door. Adequate time should also be allowed for proper sight recovery (Pastalan, 1976). In addition, night lights should be installed in and on the way to the bathroom. A switch
placed outside the bathroom, with a light built into the switch plate as a night light, can also be very helpful. Finally, lighting within the entire living environment or facility should be as consistent as possible.

**Color Perception**

With increasing age, the lens of the eye takes on a yellowish color which alters the quality of light entering the pupil. This gradual yellowing impairs the perception of certain colors, particularly greens, blues, and purples. Dark shades of navy, brown, and black are probably not distinguishable except under the most intense lighting conditions. Furthermore, differences between pastel colors such as blues, beiges, yellows and pinks are often impossible to detect. "This is why many older people will not see their room as being distinct from their neighbor's" (Hiatt, 1979, pg. 9).

One study indicated a preference on the part of older persons for primary, secondary, or tertiary colors rather than pale pastels (Jordan, 1979). For best results, these bright colors should be incorporated with lighter tones to provide a functional, yet warm, environment.

Sicurella (1977) writes "even the complete absence of glare and the most appropriate lighting, though unquestionably necessary, may do little to help visually impaired persons to see an object if there is insufficient color contrast." In a congregate setting's activity room, two pieces of contact paper can be attached to different surfaces, one dark and one light; older adults with impaired vision can use the dark surface to contrast with a light project and a light surface to contrast with a dark project. For example, when older adults assemble jigsaw puzzles care should be given to contrast table surface with the puzzle pieces.

To facilitate dining, light-colored dinnerware and a dark tablecloth can be used when serving dark foods, and dark dinnerware and a light colored tablecloth when serving light colored foods. Patterned tablecloths, which tend to confuse the eye, should be avoided (Sicurella, 1977). For maximum benefits, dishes, placemats, and tablecloth should all contrast with each other.

Color contrast is helpful in many activities of daily living (Bo-
agersox, 1978), as evidenced by the desirability of having clothing items clearly contrast with each other. Further functioning can be made easier by creating a contrast between the toothbrush and the sink, the slippers and the floor, shirt and sweater, the cookies and the plate, the handrail and the wall.

For the aged person who has difficulty in distinguishing boundaries, the use of color and/or texture differences can clarify such boundaries. For example, the color of the wall and floor should contrast and carpet should not be run up the wall.

Different perceptual tasks are involved in the opacity, transparency, and reflectivity of objects. Contrasts are crucial to being able to see an object well. It has been demonstrated that contrast (the comparison of an object’s reflectance with its background reflectance) so greatly affects visual acuity and visual performance (speed and accuracy) that, in many circumstances, contrast in visual task is more important than level of illumination. Other research has demonstrated that performance under low illumination with certain color-rendering qualities can be as good as performance under high illumination with poor color rendition (Lang et al., 1974). Colors appear different according to the surface texture and the amount of light (Hiatt, 1987). When beige, pastel yellow, and pale green are used without the addition of texture on/in walls, bedspreads, or drapery, there may be little differentiation.

Creating a beneficial psychological response through the use of color is a controversial topic. Studies have reported that certain responses can elicit certain behaviors. Reaction to color is based on our cultural background, lighting, texture, and other less obvious interactions. “We cannot arbitrarily say that a color will produce a given effect in behavior of all patients until research accounts for the interactive effect of all these variables” (Hiatt, 1984, pg. 18).

Color scheme can make use of both cool and warm color ranges. One is not limited to red, orange, yellow, or rose. Blue and green tones can be just as effective. When designing living situations for the elderly, the goal in color design is not only to make an area more aesthetically pleasing, but also to help contrast different areas or to be able to distinguish objects from their backgrounds.
Color Coding

The boldness of color coding should be striking enough to convey differences among other elements in the immediate surroundings. Because of the yellowed lens in the older eye, blues may be perceived by the elderly as green. If color is being used to enhance orientation in the long-term care setting, care should be taken to avoid painting adjacent corridors the same shade of blue or green.

One must also be aware of pattern, when dealing with color coding. Many large graphics are beyond the older persons’ visual field when they move close enough to discern the detail (Hiatt, 1979). Graphics may enforce an institutional feeling. Also items that surround a person need to have meaning for that individual. Using large graphic patterns for orientation is difficult because they have no cultural meaning for the older person. The importance of the meaning of objects has been discussed in the section on environmental attributes. Different styles of furniture, combined with a particular picture or wall hanging, give a significant cue of a certain floor or area and may be not only more aesthetically acceptable but are items that have more meaning for the individual. In a nursing home, familiar cultural cues, such as a barber pole by a barber shop, are helpful.

In the institutional setting, color coding can provide clear cues for orientation and safety, as well as serving to break the monotony of long halls and large spaces. Color coding has been experimented with in many different ways. Through the use of visual cuing, an area can be made safer and more understandable. In a study done by Liebowitz and Lawton (1979) at the Weiss Institute in Philadelphia, beneficial use of color contrast in the design was reported. Bright colors occurred frequently as accents in door jambs, nursing stations, graphics and room decor. Cooper (1986) implemented a study regarding the effect of color cuing on the functioning level of the institutionalized elderly. She demonstrated the favorable effect of enriching the environment with specific placement of color and light.

Reducing unnecessary information in the corridor of a nursing home can be facilitated through the use of color. Doorways that
have no function for the residents, e.g., storage, linen rooms, and locker rooms may be painted the background color of the walls.

Color cuing for directional purpose may not be as effective as object cues. The shape of an object, unusual architecture, a large plant, a window with a view, as well as smells, air currents, and tactile cues all give the older person spatial input. Color is simply one of many ways in which we place, and it should be used in conjunction with texture, shapes, and lighting (Cristarella, 1977; Hiatt, 1979).

**Depth Perception**

Depth perception depends on brightness and contrast, so any age-related process that affects the amount of light reaching the retina also affects depth perception (Birren, 1977). In fact, one study by Hiatt (1979) indicated that impairment in distance vision was more common than the problem of acuity.

Visual perception studies in the elderly, utilizing various illusion images, indicate that older people tend to retain their original perception and are either resistant or unable to reorganize that perception. Aged subjects also tend to show less “flexibility” in their judgements and poorer performance in gaining information from complex visual designs (Corso, 1971).

Many of these studies used tests emphasizing figure-ground perceptions. These illusions are perceptual fluctuations in which an object or figure may suddenly be perceived as background and the background as a figure. The ability to recognize a simple visual figure when it is embedded in a complex figure background is also difficult (Comalli, 1967). Studies in contrast sensitivity suggest that it may be more difficult for an older individual to discern an object on a surface with an intense pattern background (Owen, 1985).

Compensating for figure-ground problems with the elderly has specific implications when selecting floor covering. As we age, we rely on color in floor surfaces or steps or obstacles. Sometimes these detailed outlines of objects cannot be seen because of loss of depth perception. When pattern is present, as on a floor surface, it may appear to be one object or several objects (Carroll, 1978). The avoidance of patterns on floor surfaces (including stripes, checks,
and designs), particularly in hallways, living rooms, or dining rooms, is strongly recommended (Hiatt, 1980).

Owen (1985) reported that the interaction between contrast sensitivity and self motion that is involved in an individual’s ability to discriminate objects in a cluttered environment has as yet not been investigated. Therefore the contribution that floor pattern has on the incidence of falls can only be postulated. Research into this area could establish guidelines for carpet manufacturers.

Patterned floors pose additional difficulties for older people who are cognitively impaired. They may perceive patterns as objects but not be able to ask questions or otherwise determine what features are present in an environment. This author and other researchers (Comalli, 1965, 1967) have observed older persons “stepping over” or reaching for support when figure-ground surfaces with excessive contrast sensitivity are present.

Depth perception problems are also manifested through difficulty in distinguishing boundaries (corners where walls meet, the junction of the floor and wall, the level of floors at elevator stops or the edge of a door and the wall in which it is located). In these situations, contrasting colors can help to alleviate depth perception problems.

Other Considerations

In the environment of the person with senile dementia, what is not included visually is also an important consideration. To redirect the confused older adult, doorways have been camouflaged with barriers or room dividers. These screens prevent the confused person from perceiving the exits. Since those who are confused will often follow others, care should be taken by anyone living or working with the older adult as to how they enter and leave the unit. In a study to determine the most effective visual barriers to prevent ambulatory Alzheimer’s patients from exiting through an emergency door, the study demonstrated that concealing the doorknob behind a cloth panel was the most successful (Namazi et al., 1989).

Another sign of vision difficulties in the elderly involves the cornea. As a person ages, an opaque ring often forms just inside the cornea. The ring results in reduced peripheral vision because only
diffuse light can pass through the opacity (Colavita, 1978). In order to be seen by someone who experiences decreased peripheral vision and low vision, one must enter that person's visual field. This may require being within 18 to 20 inches of the person. The importance of coming very close to the visually impaired older person cannot be over-emphasized.

Even eyeglasses may be a problem. Many visually impaired individuals are unable to clean their own glasses. The build-up of sticky fingerprints can result in visual alterations that render glasses virtually useless, so daily cleaning should be provided by caregivers. Bows need tightening every three to six months. Moreover, bifocals are designed to offer comfortable reading sight, but they may hinder walking because they blur the feet and ground (Wolanin, 1981).

**HEARING ADAPTATION**

Hearing loss may have an even greater psychological influence on a person than loss of vision. Those who suffer from hearing loss often report feeling unrelated to the world around them. In many cases, depression has been found to overwhelm both the suddenly deafened or those in whom deafness develops gradually (Wolanin, 1981). Indeed, the inability to distinguish words clearly can lead to rejection and withdrawal—either self-inflicted or imposed by others.

Three kinds of hearing loss result in hearing impairment: conductive, sensorineural, and central. These types of loss can occur alone or in combination. In conductive hearing loss, the intensity is not great enough for the sound to reach the inner ear. Increasing the intensity (louder speech or mechanical amplification with a hearing aid) may restore the ability to hear. A central hearing impairment arises when the auditory nerve centers within the brain are affected. These hearing changes may occur at any age. In the elderly, the most common source of auditory problems is a sensorineural loss known as presbycusis.
Presbycusis

Presbycusis is caused by damage to the nerve endings and auditory hair cells in the inner ear. Compounding the problem of hearing perception, for individuals over 75 years of age, is the addition of a reduction in certain auditory nerve cells (Corso, 1971).

These combined losses result in difficulty in hearing high frequency sounds such as a high pitched voice or a shrill whistle. High frequency problems also arise from the inability to discern certain consonants (p, s, th, k, ha, s, sh, and ch) because consonants carry less acoustic power than vowels (Corso, 1971). Because of these two factors, the older individual is unable to discriminate between phonetically similar words making it difficult to follow normal conversation.

Meier (1978, pg. 6F) reported that older persons may hear words as if they sat on top of each other. “Instead of hearing, ‘How are you feeling today?’ the older person may hear, ‘How are you feeling today?’” Waiting a second or two for the blurred message to be processed and repeating the information slowly and distinctly will make it easier for the older person to understand what has been said. Reworking sentences also may be helpful when consonants are misunderstood.

The volume maintained for radio, television, and music in any older adult’s living situation should be assessed carefully. If volume and treble is increased in relation to the bass, the listener is exposed to overload in the lower tones. Individual adjustment of the treble and bass may compensate for loss of high frequency. Generally, persons with presbycusis are aided if the bass is turned up and the treble is turned down (Hiatt, 1979). This may require routing sound through a more sophisticated stereo system. Because of distortions, music in a high key serves to frustrate and distract rather than relax the person with presbycusis (Hatton, 1977). Music groups that perform in any type of congregate settings should ideally not include flutes and high soprano tones. Speakers and entertainers should be encouraged to use a microphone since this not only amplifies sound but also cuts out some of the high frequencies, making it easier for
the person with presbycusis to hear. Sound amplification should be available on all telephones used by the hearing impaired.

**Hearing Aids**

Attitudes toward hearing aids have changed dramatically in the last few years. One reason for this change is the hearing aid’s improved appearance. However, the technology that allows smaller and smaller hearing aids has mixed blessings for the older person. Unfortunately, the operation of smaller hearing aids requires a fine hand and finger dexterity and that is often beyond the physical capacities of older persons.

The recent advances in hearing aid design have been quite remarkable and many persons who previously were not candidates for an aid can now be helped. A hearing aid should not be purchased without an audiological examination. Federal law requires a trial period to determine if the person will benefit from the device.

Hearing aids that compensate for the lost ability to perceive high frequency sounds have been difficult to design. Technologies have been developed that will dampen certain frequencies and thus allow amplifications of only predetermined ranges. Although technically these new designs have tremendous potential the setting of the device may be difficult for the older person. The future development of these devices is quite positive.

Because of the complex nature of presbycusis, some older persons with this disorder receive only partial benefits from using a hearing aid. An aid may only make the distortion louder. Older adults should be made aware that an aid is just a mechanical device and that it has certain limitations.

Some older adults may not use hearing aids because of old batteries, improper fit, and lack of effectiveness. They may need assistance to insert the aid correctly, clean the earmold, or change the batteries.

Assistive listening devices may be used where hearing aids are not effective. These devices are not designed for continuous wear. They consist of microphone and earphones. To use such a device, the older person places the earphones over the ears with the microphone placed close to the desired source of sound (e.g., speech and
The sound then reaches the ear directly and background noise is reduced. Information concerning the availability of these devices may be obtained from an audiologist, local hearing association, or many stores that carry optical equipment.

**Background Noise and Communication**

Many elderly people with impaired hearing are reluctant to eat in restaurants or attend large social gatherings because they cannot enjoy the conversation of people around them and, therefore, feel isolated. In rooms where conversational interaction is desired, background sound needs to be reduced. The sound from dishes, fans, television, traffic, music, greatly interferes with the older person hearing pertinent speech. In the institutional setting, intercoms should be used as little as possible because this type of sound produces additional background interference. In dining rooms, persons with an identified hearing loss should not be placed near the kitchen or other noisy areas. In any group, an older person should not be placed on the periphery.

Moving into the field of vision and getting the person's attention before starting to speak are essential elements in communicating with the hearing-impaired person. To facilitate lip reading, one should look directly at the person and speak slowly and distinctly. Shouting is not only unnecessary but causes mouth distortions which make lip reading more difficult.

Older people may also have difficulty locating and identifying the source of sound. The inability to distinguish warning sounds creates tremendous insecurity. This problem, coupled with presbycusis, makes it imperative that fire and smoke alarms, which usually have a high frequency sound, should also have a visual cue, such as a flashing light. Furthermore, inability to determine the source of a sound can create auditory illusions (Wolanin, 1981).

All older adults should have ultimate control over their televisions and/or radio. When used intermittently and purposefully, such media can increase the total amount of stimulation. Radios and television are ideally used to provide a focus for socialization (Wolanin & Phillips, 1981). However, if television is in use continually its sound becomes simply one more channel of background noise. In
the institutional setting, this could be accomplished by establishing a schedule of television preferences and usage, with input provided by the residents. It is also important that the administrator and staff become sensitive to the problems created by overload of auditory sensory input. Snyder (1978), demonstrated that wandering and confusion increased in nursing homes during shift changes and other periods of high noise level.

In designing a nursing home's "Alzheimer's Unit," agitation can be addressed by decreasing the background noise. One unit selected for study had a minimum of extra traffic. As part of its design, television sets, the intercom or public address system, and ringing phones were eliminated. No medications were passed at mealtime and residents ate in small groups, reducing noises that were related to the traditional dining room (Hall, 1986). One of the greatest differences between home and the long-term care facility is the acoustical environment. "Poorly managed and designed acoustical settings can be as great a barrier to older people as steps are to a wheelchair user" (Hiatt, 1985, pg. 16).

Residences can be designed, however, to alleviate acoustical distractions. Furnishings and materials that absorb sound, reduce echoes, and muffle irrelevant noise can be introduced. The use of acoustical ceiling tile is usually the most economical and effective way to lower sound levels but carpeting, draperies, and other upholstery fabrics also reduce noise levels. Decorative baffles and wall hangings reduce background noise and add aesthetic visual appeal (Bowersox, 1979).

Insulating sheetrock should be installed around noisy areas, such as kitchens, living rooms, or maintenance and mechanical rooms. Tight window weather seals reduce exterior sound noise. On the exterior, earth berms, trees and large plant material will assist in diverting and absorbing traffic sounds. Such acoustic landscaping is of particular value in an urban setting (Bowersox, 1979).

Within the long-term care facility, sounds can be cues to certain locations. Screening out helpful sounds, such as those from the activity room, lounge, or beauty shop, may not be necessary or desirable. Each area must be examined in light of the residents diagnosis for that particular space (Koncelik, 1976).
Taste

The sense of taste consists of four components—sweet, salty, bitter, and sour—all of which are chemically induced. Schiffman (1975) suggests a decline in sensitivity with age for each of these gustatory qualities, although certain studies indicate an increased response to bitterness. Furthermore, some research suggests more of a decline in salty sensitivity in males (Corso, 1971). Medications, dentures and certain diseases also have an impact on the sense of taste. However, it appears that changes in the gustatory system do not seriously affect the sense of taste until relatively late in life.

Those who provide food service to the elderly need to be reminded of the sensory changes occurring in the aged because of the importance of the dining experience. Many caregivers report an increase in the use of condiments, particularly sugar and salt. However, these additions create problems because so many residents have either a salt or sugar-restricted diet. Therefore, the dietitian needs to find safe substitutes, such as a variety of herbs and spices, in order to provide greater taste satisfaction for the older person.

While the sense of taste is not an intricate part of environment cuing, it can be utilized for specific gustatory stimulation, such as tasting parties, e.g., wine, cheese, and ice cream. When an ethnic dinner is served, food is combined with music, costumes, dances and visual effects.

Smell

The olfactory sense provides protection and pleasure. It can generate associations of ideas and past experiences. Aromas of fresh-mown hay and rain-soaked sod conjure up more than smells. Helen Keller utilized her keen sense of smell to identify people. Moreover, two-thirds of the response to taste lies in the sense of smell (Ernst, 1976). The aroma of food changes mere acceptance into appreciation of flavor.

The literature on olfactory sensitivity is contradictory, but sensation appears to decrease with age (Busse, 1978). Besides a reduction in the pleasure of pleasant smells, the older person may have a
reduced sensitivity to body and household odors that may be offensive to others. A loss in olfaction also seems to hinder the ability to smell smoke or gas fumes. In an English study conducted by Chalke (1957), 892 deaths by domestic gas poisoning were examined. Results showed that over 75% of those who died were over 60 years of age.

The early analysis of the National Geographic Smell Survey conducted in 1986 showed a noticeable decline in the ability to detect scents at age 70 and a significant decline at age 80. One potential problem area that was revealed by this survey, involves the addition of mercaptans (foul smelling additives), to natural gas that warn of leaks. "Asked to comment on the odor's unpleasantness, older respondents showed surprising lack of strong negative reaction, possibly indicating unsuitability of the smell as a warning of danger" (Gilbert & Wysocki, 1987, pg. 522).

Long-term care organizations must be alert to the impact of smells in a facility. Smells can linger in draperies and other fabrics long after the immediate cause of the odor has been eliminated.

Opportunities also exist to increase good smells. Popcorn and coffee produce familiar odors. The smell of baking, flowers and plants, and fresh air need to be incorporated into any and all design projects. Plants that are colorful and fragrant should be placed, both inside and outside the living environment. In settings which house confused residents, plants must be of a non-poisonous variety (Bowersox, 1979).

**TACTILE/TOUCH CONCERNS**

Sensory input through the skin is subdivided into the touch and the tactile systems. An individual's system utilizes touch for awareness and protective responses and tactile input to interact with the environment. These tactile receptors allow us to perceive multiple characteristics of an object (Huss, 1977). For example, a wet rock could be cold, hard, and smooth (Walker, 1972). According to researchers, the major touch/tactile changes occurring with aging, which have implications for environmental design, are in the areas of tactile discrimination (Montagu, 1978).


**Tactile Input**

The response to a decrease in discriminatory input may take a number of forms. Such responses might include: avoiding participation in activities involving tactile discrimination, holding an object with an unusually strong grasp, having items slip from the hand or increasing feeling of items with texture. These changes, as in all sensory systems, may occur gradually or not at all (Ernst, 1976).

The importance of tactile input may at first appear contradictory. When other senses are impaired, particularly vision and hearing, the older person relies more on the tactile sense. However, with aging there are decreases in this response to tactile input. Thus, to assist the older person, the degree and variety of texture needs to be increased (Birren, 1977). This can be very beneficial in the corridor of the long-term care facility.

However, care should be taken when introducing texture into smaller areas. Too much variation of texture in a small lounge or resident room should be avoided. Textures as well as other color schemes should be carefully combined so as not to overload the individual. One dominant texture in an area is more effective than many combining varied textures (Koncelik, 1976). Coarse wall hangings made from burlap, carpet, heavy yarns, or rope will add interesting texture. Carpeting, velour, textured upholstery, and wood, not only cut down on glare, but add warmth and tactile input. Vinyl wall covering is easy to maintain and increases the tactile “readability” with definite texture. Cost can be decreased and texture increased by combining smooth painted surfaces with vinyl wall covering (Bowersox, 1979). Varied floor coverings likewise increase the degree of texture in an area. Outdoors, a distinctive surface treatment can be used to guide the older person to a particular seating area. Living spaces designed for the older adult should be assessed carefully for positive effects of varied textures in the architectural design. Large pillars, alcoves in a corridor area, and landmarks can help orient persons regarding location. The addition of items such as plants, grandfather clocks, umbrella racks, and resident mailboxes add richness and tactile variety to the environment.

Variations on the surface of handrails, such as knurling or
grooves, give cues to turns or the approaching end of a wall. Furthermore, fire and exterior doorknobs are required to have some type of textural surface for safety purposes.

In institutional settings, to allow for a variety of textures against the skin, residents should be encouraged to wear street clothes rather than institutional garments. Surrounding a person with a variety of fabrics, such as soft blankets and textured towels can eliminate total tactile deprivation.

Large raised (or recessed) letters and numbers are more effective than braille identification for the elderly person with severe sight impairment (Bowersox, 1978). Most visually impaired elderly have never learned braille, and when there is tactile loss the texture of braille may not be varied enough to serve as identification.

When temperature sensitivity occurs in older persons, most people report a greater susceptibility to cold than to heat (Birren, 1977). Older persons often require lap robes and sweaters in temperature settings that appear quite warm to the younger person (Carroll, 1978). Outdoor environments should be protected from breezes with fences or baffles.

**Touch**

Many researchers note the elderly person's need to be touched. Touch enhances the feeling of well-being, but as people age, they have fewer significant others with whom touching is acceptable behavior. "One has only to observe the responses of older people to a caress, an embrace, a hand-pat or a clasp, to appreciate how vitally necessary such experiences are for their well-being" (Montagu, 1978, pg. 321). Animals and children add considerably to touch input in the environment.

Caregivers may need to learn the importance of using a caring touch with the elderly, as well as learning to give and receive touch comfortably (Huss, 1977). Occasionally an aversion to being touched may be present because of certain physiological, cultural, and social factors. Those who care for older adults must be aware that this can occur, and should use touch at the level that is comfortable for the older person (Wolanin, 1981).

For the seriously ill or confused, touch is a valuable communica-
to investigate the effects of touch with seriously ill pa-
tients, one study compared a group of subjects who were touched
while talking with the study's investigator to a control group who
were not touched. The findings demonstrated that use of touch
showed seriously ill patients that the nurse cared about them (Mc-
Corkle, 1974). In fact, as a person's length of stay in the nursing
home increases and he/she establishes closer ties to the nursing
staff, touch deprivation may actually become less severe. Emotion,
perception, motivation, drive, wakefulness and sleep are all associ-
ated with neurological and brain activity as well as outside stimuli
(Noback, 1975).

One other important aspect of touch in the nursing home is the
attachment to meaningful objects. Personal items take on special
importance to the long-term care resident. Huss (1977) relates a
study where the elderly clung to possessions they could handle or
possessions that evoked memories. Multiple studies on reminis-
cence and life review lend credence to this observation. In the sec-
tion on environmental attributes there is an in-depth discussion of the
meaning the older person may attach to objects.

KINESTHETIC INPUT

Kinesthesia, the position and balance sense, has two groups of
sensors. The proprioceptive sense is located in the joints and deep
tissue of the limbs and indicates the position of body parts in space.
The major age-related problems in proprioception result in: (1) de-
creased ability to judge an object's weight, (2) decreased awareness
of the position of body parts which is coupled with other musculo-
skeletal changes and (3) decreased coordination and speed of con-
traction (Birren, 1977). This decreased feedback in proprioception
results in deficits in motor coordination because perception of body
movement is critical to performing skilled activities.

The vestibular portion of the inner ear gives input concerning an
individual's head position. The older person with changes in the
vestibular system has a decrease in the ability to determine when
and in what direction the head is moving. This leads to an increase
in the possibility of falling (Hasselkus, 1974). Environmental adap-
tation can compensate for certain losses in these senses.
Proprioception

Proprioceptive changes cause the elderly to move more slowly. The step of older persons is shorter, higher, and wider-based, with more time spent in support before the next move is made; thus, the older person should never be rushed when walking (Murray et al., 1969; Finely et al., 1969). They should, however, be involved in activities that provide moderate amounts of physical activity. Proprioceptive response is essential to perform activities of daily living. Additional input can be encouraged by providing walking, dancing, and exercise groups (Richman, 1969).

Hiatt (1979) has indicated that many falls can be traced to the older person’s sudden weight shift in relation to a mirror-like waxed floor. Such falls may be exaggerated by osteoporosis, cardiovascular disorders, muscular weakness, and, of primary concern in this section, dizziness and decreased input from the muscle and joint receptors (Birren, 1977).

The cause of all falls needs to be determined, and the possibility of environmental interventions needs to be evaluated. Although floor surfaces were mentioned in a previous section, further comments are necessary.

Floor Covering

Of the various types of floor covering on the market, vinyl composition tile (VCT), sheet vinyl, and carpet are the most popular. VCT accommodates wheelchair traffic, is relatively inexpensive to install and has adequate color choices. However, it also requires extensive maintenance, is noisy, produces glare and has an institutional appearance. Sheet vinyl on the other hand accommodates wheelchair traffic, is more expensive to install, has good color choices, and requires medium-high maintenance.

Carpet has approximately the same installation price as sheet vinyl but produces more drag on the wheels, which may cause difficulties for some wheelchair users. Carpet also requires that spills be cleaned immediately. Overall, though, a feeling of warmth and comfort is projected by carpet; it is quiet, traps air-born bacteria dust; and has a wide color and texture range. Older adults also appear to feel more secure on carpet. Gait speed and step length have
been demonstrated to be significantly greater on carpet than on a vinyl surface (Willmott, 1986). Although installation costs for VCT are the least expensive, user-cost comparison shows carpet, over the lifetime of the product, to be less expensive (Reznikoff, 1979). Maintenance of carpet and vinyl flooring are entirely different, but either one can be used in most areas accommodating older individuals. Carpet squares have been successfully used in some situations, particularly in high traffic areas where they can be easily replaced at minimal expense.

The older adult’s floor surface should also be free of unnecessary obstacles. Throw rugs, door thresholds and trailing telephone and extension cords should be eliminated.

**Ambulation Aids**

Handrails should be placed on both sides of the hall since ambulatory elderly may have use of only one side, e.g., after a stroke or because of neurological involvement or amputation. Observations of ambulation in nursing homes have shown that only a minority of ambulatory residents actually use the hand rail for assistance while walking. In these settings, handrails are used primarily by the person in a wheelchair who pulls him/herself down the hall using the handrail as an ambulatory assist. Koncelik (1976) has suggested that ideally there should be two handrails on the same wall, one placed at 32 inches and the other at approximately 26 inches, to allow for use by both the ambulatory and nonambulatory person. The shape of the handrail itself is also a consideration. Handrails should be selected which provide the older hand with comfortable grasp and maximum safety. The best handrail design is cylindrical in shape and 1 1/4 to 1 1/2 inches in diameter.

Some type of support should also be available through open areas, as in dining rooms, living rooms, and day rooms. Tables should be sturdy because most older people will use them either for support when rising from a chair or for balance when walking.

If older adults are using stairs, a four-inch height is preferable to the usual eight inches. Women, in particular, tend to “let down” from one step to the next with a jarring motion, so a shallower step lessens the likelihood of injury (Hasselkus, 1974).
Balance

Muscle tone and postural adjustment also are dependent upon the vestibular system. Injury to the inner ear and the auditory nerve has consequences other than total deafness. Flabbiness of the neck, limb, and trunk muscles along with disturbed action of the eye muscles are likely to occur (Gelard, 1953). Decreased strength in the postural muscles of the trunk may lead to a reduction of balance and equilibrium reactions. Whereas, the younger person merely tilts forward to maintain balance, the older person has a decreased ability to determine when the body is tilting. Thus, adjustments in posture are required and this often leads to falls.

Postural changes include a forward shift in the center of gravity resulting in greater body weight on the toes. Because of postural changes, the older adult may find it easier and safer to negotiate stairs rather than ramps (Hiatt, 1979). Although a ramp is required for the wheelchair user, certain hazards exist for ramp usage in the long-term care facility. For the older ambulatory adult, the combined effects of that person's lowered gaze, forward tilt due to osteoporosis, and incline of the ramp may all contribute to a dangerous alteration in balance when the person is walking down the ramp.

The older wheelchair user may also have some difficulty with ramps. Because of reduced upper extremity strength in the elderly, ramps may be too steep for the older person to negotiate. Any ramp for the older adult should have a pitch of 1:20 rather than the accessibility standard of 1:12.

Those who care for impaired older adults should use caution when moving the wheelchair-bound person. The change in the ability to process vestibular information may make the world appear to be moving much faster than it is and this can create fear for the impaired individual.

Although disturbances in the vestibular system may cause dizziness, other problems may also contribute to such a reaction. For example, a person may have arteriosclerotic changes of the blood vessels of the neck and/or deterioration of neck vertebrae resulting in reduced arterial flow. Both processes may create problems in circulation to the brain. Dizziness or even unconsciousness may
Margaret A. Christenson

occur when the person turns his neck or looks upward. Therefore older persons should be cautioned not to make quick head motions either from side to side or upward and not to sit or stand with their head tipped back for a prolonged period of time. These conditions give further credence to placing signs and directional information at their proper heights as well as the necessity for not locating the television set high on the wall. The seated older person needs the set placed near eye-level.

Changes in posture due to osteoporosis are another reason for lower sign placement. Even to compensate for vision and hearing deficits, residents should not be seated at a movie, concert, or religious service, in a position requiring the head to be tipped back for a prolonged time. The height of clothing rods and shelves in closets, and the location of a television set should take into consideration the effect on head position. Because of the difficulty in turning the head from side to side, these limitations also reduce social interaction when people are seated next to each other on benches or sofas. Socialization increases when persons are seated at right-angles to each other.

Antibiotics that cause hearing loss also affect the vestibular portion of the inner ear and may cause dizziness. Prolonged use of these drugs should be monitored.

Tactile, kinesthetic, and vestibular stimulation have been relatively unexplored with regard to the elderly. Even recognition of the importance of touch to normal development and adequate functioning at earlier stages is fairly recent. Research by Kramer and Piermont (1976) has documented that preterm infants rocked mechanically on waterbeds and given auditory stimulation gained significantly more weight than nonstimulated infants. Harlow's experiments with rhesus monkeys deprived of touch and kinesthetic stimulation showed that these monkeys resorted to body rocking in the same way as human children, raised in institutions, who were touched and cared for infrequently (Montagu, 1978).

Rocking behavior is commonly seen in the disoriented elderly. Is this self-induced movement an attempt to increase vestibular stimulation? The need for self-determined vestibular input can be encouraged by including rocking chairs in the person's environment. Outdoor porches are a good investment for resident well-being,
particularly if porch swings and rocking chairs are included. If swings are used, the arm of the swing should be part of the support system of the chair and not moveable.

**CONCLUSION**

In our twentieth century society, alert, active “senior citizens” have become commonplace. However, the homes of these independent seniors may have potential hazards that need to be assessed to determine interventions which will maximize their functioning. Residents as well as managers of senior housing are extremely reluctant to include interventions, such as handrails in corridors or grab bars in bathrooms, that are construed to convey less than total independence. These individuals need information regarding the benefits of including unobtrusive and yet specific adaptations that will promote independence.

“The nursing home environment must project a ‘can do’ image. The atmosphere must promote independence rather than dependence and at all times should accommodate the deficits of normal aging” (Erickson, 1989, pg. 18). In the long-term care facility the input of the staff is essential if these design interventions are to have optimal effect. In a study done by Hanley (1981) the orientation of residents was improved through the active involvement of the caregivers. Sights, sounds, smells, and textures in the environment should be used to relate to the residents.

Regardless of the setting, sensory impairment can be compensated for, to some degree, if the environment is designed and modified to allow individuals to operate at their maximum potential. With greater knowledge, planning and conscious effort, environments that stimulate, work for, and respond to the sensory needs of the older person can be a reality.