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Three Approaches to Lighting for Senior Living

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As the aging population in the United States continues to grow, designers and architects are beginning to design projects with the healthcare needs of older adults in mind. Design professionals are striving to integrate the end user's needs with the intent of the project and the client's specifications. To accomplish this goal, they need access to the most up-to-date information. Establishing a foundation of credible, current research ensures that clients and designers can make evidence-based decisions, enabling them to meet the end user's needs by creating a space that positively impacts their wellbeing.

For people over the age of 65 ("older adults"), architects and designers must address biology-based aging and incident-based frailty concerns. Particular concerns include fall risk, socialization, physical and mental stimulation, and well-being. The application of research can inform strategic design approaches to properly address the needs of older adults.

Lighting is an area of particular importance to older adults. Over the last decade, rapidly evolving technologies have impacted the human experience of interior environments. Research has found that older adults frequently perceive lighting in their environments as "good enough." However, studies have shown that in reality, most spaces designed specifically for older adults are severely underlit.

Older adults' inaccurate assessments of lighting may be attributed to the fact that age-related vision loss generally occurs gradually. Research has shown that older adults are often unaware of the change in their vision, and so they continue to light their environments with the same floor lamps, table lamps, and nightlights as they have always used.

Research points to several reasons that architects and designers inadvertently include inadequate lighting in spaces designed for the aging population:

- **Design professionals and facility managers establish lighting conditions based on their (or their work force's) younger eyes, unaware of the additional needs of older eyes. Even when they reference the Illuminating Engineering Society (IES) recommendations for foot candles, most are unaware there are three different recommendations that are based on the user's age and degree of vision loss.**

- **In new construction, design professionals and facility decision-makers generally do not have access to credible research that would help them to push back against budget restrictions, project deadlines, or other pressing factors.**

To address this issue, M+A Architects partnered with a group of design researchers to complete an audit of peer-reviewed research concerning lighting for senior living. The research generated three categories of lighting effects: EMOTIONAL BALANCE, PERFORMANCE, and FALL PREVENTION. Based on these findings, we propose three strategic, health-based approaches to planning, installing, and using lighting in senior living environments.

Approach 1: Light for Emotional Balance

Older adults in senior living and long-term care often have limited access to daylight and the positive biological and emotional balances it provides. Through the strategic application of artificial light, architects and designers have the opportunity to produce lighting layouts that similarly capture the positive attributes of natural light. Through variations in brightness and color temperature, lighting can positively affect the mood of older adults.

With advanced lighting technologies, design professionals now have the ability to create a dynamic artificial lighting system that mimics the qualities of daylight, including the flux of daylight levels. This is a significant advancement. Research has shown that older adults prefer a dynamic system that rapidly increases light level over 6 seconds, then slowly decreases it over 354 seconds, rather than a system that rapidly decreases and then slowly increases light levels (Izsó, Laufer, Suplicz, 2009). For older adults, a dynamic system can create the feeling of being continually in bright light, rather than in darkness. A dynamic system can elicit in older adults the pleasant feelings of daylight.

Lighting can be a significant factor in creating ambience, and a person's mood may be influenced by an environment's artificial light. Existing research indicates that younger adults experience emotional changes under different qualities of light; therefore, designers should be aware of similar emotional changes in older adults.

> **If designers use cool color temperature lighting (4000K) in high-stress environments, it may help slow the development of negative moods in older adults (Knez and Kers, 2000). In this research, warm light (3000K) actually increased the development of self-reported negative moods.**

Other researchers have attempted to reduce anxiety in older adults through the use of an "activating" ambience, using 325 lux, 4000K color temperature, and blue light accents (Kuijsters, Redi, de Ruyter et al., 2015). This activating ambience did not produce a significant reduction in anxiety. However, these researchers were able to counteract feelings of sadness with a "cozy" ambience, using dim light of 120 lux, 2700K color temperature, and orange light accents (Kuijsters, Redi, de Ruyter et al., 2015). Although researchers did not observe a significant impact with the activating ambience, there did notice indications that brightness and color temperature could become tools to encourage emotional balance. Design professionals could implement these color temperature strategies in senior living spaces to counter the stress and anxiety older adults sometimes feel.

Color temperature scale to show ranges of lighting from warmer to cooler.

Architects and designers should also consider how lighting can affect an older adult's comfort and satisfaction with an environment. Often, builders of senior living facilities do not evaluate the preferences of older adults before selecting lighting and finishes. For older adults, an interior that feels bright also feels warmer and more comfortable (Oi, 2005). Older adults are more content when an environment has a well-layered lighting scheme that uses ceiling-based general lighting, wall sconces, and accent or decorative lighting. This layering also relates to the perception of brightness and choice of use. In a common lounge with this lighting scheme, an older adult could choose to sit in areas with more direct light from the accents (such as a table or floor lamp) to read. They might choose to sit elsewhere to have a relaxing conversation with a friend. In addition, when there are lights on multiple surfaces, there are fewer shadows. This can help older adults feel more comfortable and physically stable when moving through the space.

It is important to strive for a sense of balance with the emotional quality of lighting in senior living residences. Older adults in these communities feel stress, because they are in new territory after moving from the homes they have owned for years. They also feel stress because they are in a healthcare-oriented facility. All these negative emotions can have a significant impact on their satisfaction with their environment and their lives. With thoughtful approaches to lighting and color temperature, designers may be able to design environments that help reinforce positive moods in older adults.

Approach 2: Light for Performance

When light levels are too low to meet older adults' needs, they may have difficulty performing daily tasks, such as reading (up close or at a distance), sorting medications, and other activities of daily living (ADLs). Poor lighting has a negative impact on older adults' concentration, speed, and task accuracy. Fortunately, there are a number of ways that designers can increase the quality and brightness of lighting in senior living environments in order to better support the functional activities of older adults.

Performing daily tasks may require varied levels of lighting and should be considered on a case by case basis.

For navigation, memory, and ease of use, older adults must be able to clearly identify where they are and where they are going. High-intensity, glaring light paired with low-contrast signage minimizes an older adult's ability to accurately read information (Elton, Johnson, Nicolle et al., 2013). These conditions make it difficult for older adults to read signage within and outside of senior living. A study found that overcast or low-glare conditions and high-contrast signage is the combination that makes reading easiest for older adults. Even with reduced contrast, the overcast condition produced higher success rates than in-house (direct) lighting (Elton, Johnson, Nicolle et al., 2013). Therefore, indirect lighting can significantly increase an older adult's

ability to recognize and read signage at a distance.

A different study indicated that a lamp's color rendering index (CRI) and correlated color temperature (CCT) are important factors in helping older adults see details and signage in public environments. Higher CCT, such as 4100K, and CRI over 85 improve an older adult's experience of the environment, including improved visual clarity and visual comfort (Park and Farr, 2007). Other design elements that help older adults and those with impaired vision include light-colored walls that contrast strongly with the floor (De Lepeleire, Bouwen, De Coninck et al., 2007). In addition, walls that have a low reflectance value reduce glare, which also helps older adults see.

As we age, it is common to develop conditions that result in lowered vision, such as cataracts and age-related macular degeneration. Interior lighting affects the ability of older adults with vision problems to perform ADLs. Many older adults with vision issues identified bright light as the most comfortable and low light as the least comfortable (Evans, Sawyerr, Jessa et al., 2010). However, the study infers that the best approach to providing lighting for older people is to investigate, on an individual basis, the effect of different light levels. The study results do not support the idea that "one light level fits all." Rather, they indicate that older adults with reduced vision should be active participants in determining the light level that they find best for them. One suggestion was to have an on-site "test room" where the light level can be varied in order to find the optimal setting for an individual before he or she moves into a new apartment (Evans, Sawyerr, Jessa et al., 2010).

In summary, nonglare lighting is a key factor of environments that are easier for older adults to navigate. This type of lighting helps makes it possible for older adults to remain independent, whether they live in senior living communities, long-term care, or on their own. Older adults can better navigate new spaces when there is a strong contrast between surface finishes and when the spaces feature high-contrast signage in which letters and information are easily distinguishable.

Approach 3: Light for Fall Prevention

Dimly lit corridors can increase fall risks.

Brightly lit corridors with contrasting finishes can help reduce falls and increase mobility.

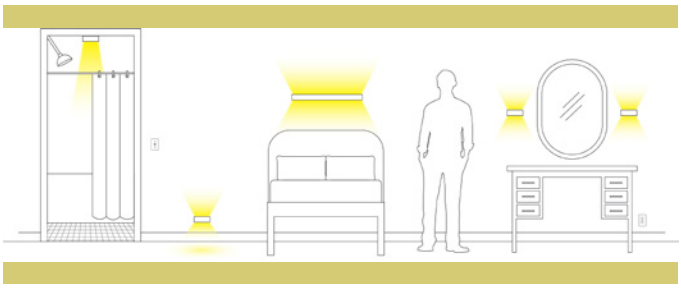
The amount of light in nursing homes is seldom sufficient to meet the visual needs of older adults. This lack of illumination may create a higher risk of accidental falls for all residents (De Lepeleire, Bouwen, De Coninck et al., 2007). Fall risk increases with age. When fall risk is combined with naturally declining vision and insufficient interior light levels, senior living communities can become dangerous to their own residents. Appropriately increasing light where falls are most likely to occur can balance resident safety with design intent.

Older adults have more trouble walking through rooms at night, when light levels are low, than they do during the day, when bright sunlight illuminates

rooms. When the mobility of older adults with visual impairments was evaluated with bright and reduced lighting, both indoors and out, researchers (Kuyk, Elliott, Fuhr, 1998) found significant changes in capability. Researchers recorded the frequency of mobility problems, including running into objects; searching with hands or feet; losing balance; having an interruption in normal gait; straying off path; having constant contact with surrounding objects; stopping unnecessarily; needing spotter intervention; and missing landmarks. These issues increased 121% when the light levels were low indoors and 291% when light levels were low outside (Kuyk, Elliott, Fuhr, 1998). During on-site evaluations and POEs, designers can observe if these mobility problems occur. These observations will help them to evaluate if the lighting is appropriate for older adults. If designers observe residents searching with their hands or regularly bumping into objects, it could be a sign that the interior lighting is not sufficient for residents' needs (Kuyk, Elliott, Fuhr, 1998).

Older adults are very likely to fall during the night. Their fall risk is also increased when they change positions, such as when they rise from a sitting to a standing position. For older adults who had fallen before, research has shown that low illumination from LED strips placed around a door frame is the most helpful feature in reducing transition time from sitting to standing (Figueiro, Gras, Rea et al., 2012). A high ambient light level of 650 lux was nearly as helpful. However, there are several reasons why the LED strip system is superior to a high ambient light level. The LED strip system provides visual cues in low ambient illumination and reduces weight transfer time in older adults. It is a good example of how lighting can be used to reduce fall risks in older adults without disrupting their sleep by turning on a bright light (Figueiro, Gras, Rea et al., 2012).

In one study, ceiling-mounted light was best for success in balance-oriented tasks (Figueiro, Plitnick, Rea et al., 2011). However, at night, turning on a bright overhead light can be very disruptive to sleep patterns. Therefore, the best choice for nighttime lighting might be illuminating pathways and providing subtle lighting through nightlights. This can improve gait and balance in older adults without disrupting their sleep. The addition of perceptual cues that define the horizontal walking plane also can potentially reduce fall risks in older adults (Figueiro, Plitnick, Rea et al., 2011). Each example from research clearly indicates that reduced lighting hinders older adults' ability to safely and accurately navigate their environment, whether indoors or outdoors. Having sufficient light for older adults in senior living and long-term care can have a significant impact on their day-to-day routines and ability to remain independent.



Typical lighting locations to help reduce risk of falls in room.

Next Steps

What is clear from this evaluation of existing research is that creating a lighting plan for older adults is a complex and multi-faceted process. The three approaches outline above can begin to guide architects and designers in effectively addressing some of the health-related lighting issues older adults face. The list of needs is long, ranging from balancing artificial and daylighting strategies to providing appropriate entryway, employee, and residential lighting. However, these approaches provide actionable steps—guided by research—for the development of a layered lighting strategy that will improve the lighting conditions for senior living.

M+ A Architects and the Department of Design at The Ohio State University commissioned this white paper, participating in discussions to finalize the research question and identifying relevant research that explores the question examined in the paper. M+A Architects uses this and other evidence-based research to support our decision-making process. To continue the conversation on lighting, senior living design, and other services we can provide, contact us at research@ma-architects.com.

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