

# EBD

Evidence  
Based  
Design



# 1

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## Journal 1: Aged Care

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evidence-based strategies  
for the design of aged-care  
environments

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## What is Evidence Based Design Journal?

Performative spaces must now be designed to evolve as rapidly as the needs of those that occupy them.

Driven by enormous advances in ICT, the world is experiencing a period of unprecedented social change—one that has placed extraordinary demands on our built environments, and on our understanding about how they work for the people that actively occupy them. The impact of social interaction on our health and sense of wellbeing is now also recognised as a significant driver in the design of new environments and the need for ongoing research.

Although the act of designing has always been—and always will be—a process of discovery, the question is: upon what do we base our speculation in an evolving social context? An evidence-based approach is not linear or static, nor does it provide a ready-made suite of answers, it simply means that we look beyond the limitations of our own knowledge for reliable information upon which to base our process.

This approach is now critical for the design, production and operation of urban, work, retail, health, learning, transport, aged care and cultural spaces—anyplace where the built environment can have a real and significant impact on an occupant's experience and performance.

The aim of EBD is to create a bridge between research and design practice, augmenting the existing knowledge of organisations, communities, architects and urban planners, their clients and end users, with available evidence about the ways in which people interact with the new and complex environments that we now occupy. Predictable, or not, reliable information about anthropospatial behaviour can inspire new thoughts and ideas.

At EBD, our ambition is to refocus architectural thinking on the person and refine the concept of what data might be. A single story can be data and, in sufficient quantity, that data can become evidence. The problem for design professionals is that such evidence is not readily available outside of the realm of academia, and it is not often gathered with the act of design in mind—it requires filtering and interpretation—and that is where EBD comes in.

If you support what we are doing, then please get in touch and follow us on our social media sites. Through the EBD blog, there will be opportunities for our readers to contribute their knowledge and experiences because, most of all, we want to know what you need to know. For EBD to grow and evolve then we also need your critical feedback. We are very excited about this new venture and we are looking forward to hearing from you soon.

All the best,  
Darragh O'Brien

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## Journal One: Aged Care

For this inaugural issue of the Evidence Based Design (EBD) Journal we focus on a building type that has been rapidly evolving over the past thirty years: the residential aged care facility, or nursing home. With a growing global trend towards the concept of aging-in-place, residential care facilities are now evolving programatically to meet multiple, complex needs:

- a social and administrative hub for community-based programs.
- residential care for those with significant physical health issues and/or dementia.
- transitional and respite care.
- palliative care outside of a hospital setting.

In the production of this issue, EBD has placed particular emphasis on designing for dementia.

We have reviewed over 1,190 research publications and selected 215 articles that are most relevant to the design process.

All articles have been written with non-academics in mind, by acknowledged experts in the fields of architecture and gerontology. Each article has been reviewed by an esteemed panel of academics, with significant experience in research and design practice.

### Content Overview:

The journal is presented in three distinct sections:

1. 2 x articles on:
  - The role of evidence in the design process, and
  - The use of new and emerging *smart* technologies.
2. 35 x individual evidence-based design strategies based on 6 primary principles:
  - Orientation
  - Independence
  - Stimulation
  - Safety and security
  - Home
  - Private-public life.
3. 2 x significant case studies of contemporary facilities from Italy and Germany.

We hope you find this publication both useful and stimulating and look forward to hearing from you about ways to improve each issue.

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## Managing Editor: Darragh O'Brien



**Darragh O'Brien**  
B.Arch. Sc., Dip. Arch.  
h1 PhD

Dr Darragh O'Brien is the managing editor of Evidence Based Design. He is also a principal of Architectural Research Consultancy and spent five years as founding director of the Spatial Research Group at Monash University, Melbourne.

With over twenty years' experience as an architect, he also holds a PhD on the evidence-based design of performative architectural space. Darragh specialises in post-occupancy analysis and has developed a unique set of research tools to help us understand the way people interact with the environments that we occupy. His research interest is in the role of knowledge in a creative design process. His current research focus is on the use of new technologies in the design of care facilities for dementia and palliative-care residents.

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## Editorial panel



**Richard Fleming**  
B.Tech.(Hons), Dip.Clin.  
Psy, PhD

Richard Fleming is a psychologist who has worked with the elderly for more than thirty years. While occupying the position of Regional Coordinator of Mental Health Services in the S.E. Region of NSW he played a major role in the deinstitutionalisation of psychiatric services by leading the design and development of the units for the Confused and Disturbed Elderly (CADE) for the NSW Department of Health.

He established the HammondCare Dementia Services Development Centre in 1995 and in 2010 he was appointed as a Professorial Fellow in the Faculty of Health and Behavioural Sciences in the University of Wollongong and as Director of the NSW/ACT Dementia Training Study Centre.

He has published papers on environmental design, reminiscence therapy, reality orientation, depression, assessment of the elderly and service evaluation and is the principal author of books on care planning for people with dementia, environmental design and a comparison between Australian and Japanese dementia care.



**Tanya Petrovich**  
B.Sc Hons, PhD

Tanya Petrovich is Business Development Manager, Learning and Development, Alzheimer's Australia Vic.

She completed studies in the field of Genetics and Neurobiology at the University of Melbourne and Post-Doctoral studies at the Marie Curie Research Institute, UK. She has spent many years teaching in the fields of Science, and Health Science. She joined Alzheimer's Australia Vic in 2008.

In 2012 Tanya was instrumental in initiating consulting services on the built environment. She also led the development of the Virtual Dementia Experience in the immersive sensory environment at the Perc Walkley Dementia Learning Centre. The Virtual Dementia Experience gives participants an understanding of what it might be like to have dementia and also how the built environment impacts on the person living with dementia.



**Birgit Dietz**  
Dr. Ing, Architektur

Birgit Dietz is CEO of Dietz-hcf and a member of the "Bavarian Institute for dementia-friendly architecture". She has a degree in architecture and was awarded a PhD by the Technical University Munich for her research on the Heidelberg University Hospital. She now works in research, education and planning. Her breadth of experience in delivering both small-scale upgrading projects and larger extension and refurbishment projects with a strong emphasis on dementia-friendly design has led to her involvement in many additional projects. Birgit is passionate about the benefits of good design in care homes and hospital environments, delivering better quality of life for patients, residents and staff, and thus also achieving better performance for managers and commissioning staff.

## Issue 1 Contributors

**Joost van Hoof**  
Dr. Ir



Joost van Hoof is head of the Centre for Healthcare and Technology of Fontys University of Applied Sciences in Eindhoven, The Netherlands.

He holds an engineering degree in Building Physics and Services (2004) and a doctorate (2010) in the field of ageing-in-place for older adults with dementia, both from Eindhoven University of Technology.

His research activities are related to housing for older people, in particular older people with dementia, and nursing-home residents. Together with partners from the industry and the Dutch Alzheimer Society, he constructed a demonstration dwelling and a website on home modifications for people with dementia.

**Gesine Marquardt**  
Dr. Ing, Architektur



Gesine Marquardt obtained a Master's degree in Architecture from the University of Stuttgart, Germany. In 2007 she was awarded her PhD and several research awards for her thesis on "Dementia-friendly Architecture".

Her research focuses on how the physical environment can be designed for equal access by all users, regardless of age, disability, or cognitive impairment.

In 2012 she was awarded funding by the German Research Foundation to establish her own researcher's group on "Architecture under Demographic Change".

**George Demiris**  
PhD, FACMI



George Demiris is the Alumni Endowed Professor in Nursing and Professor of Biomedical and Health Informatics in the School of Medicine at the University of Washington, where he serves as the Director of the Clinical Informatics and Patient Centered Technologies Program. He obtained his PhD degree in Health Informatics from the University of Minnesota. His research interests include the design and evaluation of home-based technologies for older adults, smart homes and the use of telehealth in home care and hospice. He has served in the past as Chair of the International Medical Informatics Association Working Group on Smart Homes and Ambient Assisted Living, and the Lead Convener of the Technology and Aging Special Interest Group of the Gerontological Society of America.

# PDF Capabilities

EBD Journal contains both standard and interactive PDF capabilities. To maximise the full interactive potential of the EBD Journal, it is suggested that you have installed the most recent and up to date version of Adobe Acrobat Reader or equivalent PDF viewing software. You will then be able to activate interactive features including images, notes and web links.

**Limitations:**  
EBD Journal cannot guarantee full interactivity when the PDF is viewed on tablet and mobile devices (eg iPad). Additionally, certain desktop PDF viewers (eg browsers & third party desktop software) may not fully support interactive features. However, for the purpose of printing, all references and notes are also reproduced at the back of the journal.

- Standard PDF Features:**
- Ability to click on contents to go to page.
  - Ability to search for specific terms in the document.
  - Ability to bookmark and copy text.

# Interactive Capabilities

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### Design Strategy 1F: Priming

It is hypothesised that orientation strategies based on implicit not explicit memory, <sup>10</sup> can potentially enable residents to move between destinations, without having to think about how to get from one place to another. Priming is defined as the use of repetitive stimuli to produce a non-cognitive response. Strategies could include the use of short, looping circulation paths, a unique sequence of unobtrusive route identifiers and nodes with clear lines of sight to the next destination.

Effective orientation scenario

View through to external garden or street, but can be any attractor/niche that differentiates

Use of colour unique to a particular route can differentiate one path from another and aid non-cognitive priming.

A Path from the dining area through to bedroom

B Destination

For frequently travelled routes, wayfinding relies on cognitive abilities beyond explicit memory. <sup>19</sup>

Residents with Alzheimer's disease, with medial-temporal lobe damage, can retain their implicit memory <sup>10, 20</sup> for object information relevant for navigation. <sup>21, 22, 14</sup>

However, those residents with dementia with Lewy bodies continue to perform poorly in orientation tests. <sup>23</sup>

### Design Strategy 1G: Light and sound

Provide adjustable lighting zones to allow flexibility in lighting levels based on the needs. (Refer to principle 4D for more detailed information) Reduce reverberation time through the use of absorptive materials.

Sound

The scale of individual social spaces can have a significant impact on noise levels. In addition to main social areas, provide free access to alternative "niche" spaces, for residents to "self-select" levels of sensory stimulation.

Smaller niche creates very quiet social spaces

Quiet/Semi Public Loud/Public

Legend: Bedrooms, Quiet Social Spaces, Loud Social Spaces

Light

In larger social areas, residents can choose between areas of differing light qualities. In smaller social areas and bedrooms, residents have the ability to adjust the amount of direct or indirect light present within certain spaces (Adjustable Zones).

Adjustable Zone

Legend: Bedrooms, Quiet Social Spaces, Loud Social Spaces

Quiet environments have also been associated with diminished levels of agitation. <sup>16</sup> In Netten's 1993 study of 79 dementia residents at 13 long-term care facilities, higher levels of orientation were associated with quiet environments. Researchers theorised that disorientation followed residents' attempts to "shut out" noisy environments. <sup>16</sup>

Wayfinding among residents can be less successful in facilities with low lighting levels in public areas. <sup>16</sup>

EBD Journal Design Principle 1: Orientation 11

1 Untested 2 Conflicting

Reliable theory from a relevant discipline that has a potentially high impact but has not been adequately tested in an architectural context. Design strategies therefore remain hypothetical.

Roll over on colour code to reveal category of research (quality). Assisting the reader to understand the limitations of each piece of research.

Click on dot to enlarge image/diagram/photo, use X to close.

F

X

For frequently travelled, wayfinding relies on cognitive abilities beyond explicit memory. <sup>19</sup>

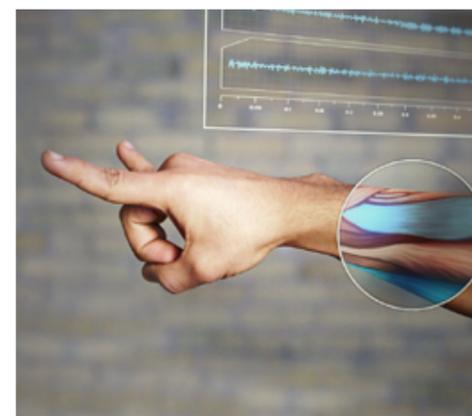
Close

[19] Sanders, A. E., Holtzer, R., Lipton, R.F., Verghese, J. (2008). Egocentric and Navigation Skills in Older Adults. *Gerontology*, Vol. 63A, no. 12, 13. <http://www.ncbi.nlm.nih.gov/PMC2673537/> (Free)

Click on superscript number <sup>1</sup> to reveal notes and literature references. References include links to original publication websites where available, saving the reader valuable time.

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## Contents



# Designing for Dementia

A critical overview of the evidence-based design of housing for people with dementia

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Discussions about the importance of the built environment for healthcare delivery extend at least as far back as Hippocrates<sup>1</sup> (400 BC). The iconic Florence Nightingale (1859) also strongly believed in the influence the indoor environment has on the progress of disease and recovery. Today, the role of the built environment in the healing process is of growing interest to healthcare providers, environmental psychologists, consultants, and architects. Although there is a mounting evidence<sup>1</sup> linking healthcare environments to health outcomes, because of the varying quality of that evidence, there has also been a lack of clarity around what can and cannot be achieved through design.

Given the ageing of society and the ever increasing numbers of persons with dementia in the Western World, the need for detailed knowledge about aged care environments has also become increasingly important. The mental and physical health state of these persons is extremely fragile and their needs demand careful consideration. Although environmental interventions constitute only a fraction of what is needed for people with dementia to remain as independent as possible, there is now sufficient evidence<sup>2,3</sup> to argue they can be used as a first-line treatment, rather than beginning with pharmacologic interventions.

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## The Knowledge Problem

The systematic study of the effects the built environment and the application of research findings is often referred to as evidence-based design. However, to be effective, evidence-based design requires full-bodied research efforts, a large amount of valid information and a speculative approach to design practice.<sup>4</sup> In reality, some evidence can be methodologically flawed and is always evolving. The problem is that not all evidence is created equal.<sup>5, 6, 7, 8</sup>

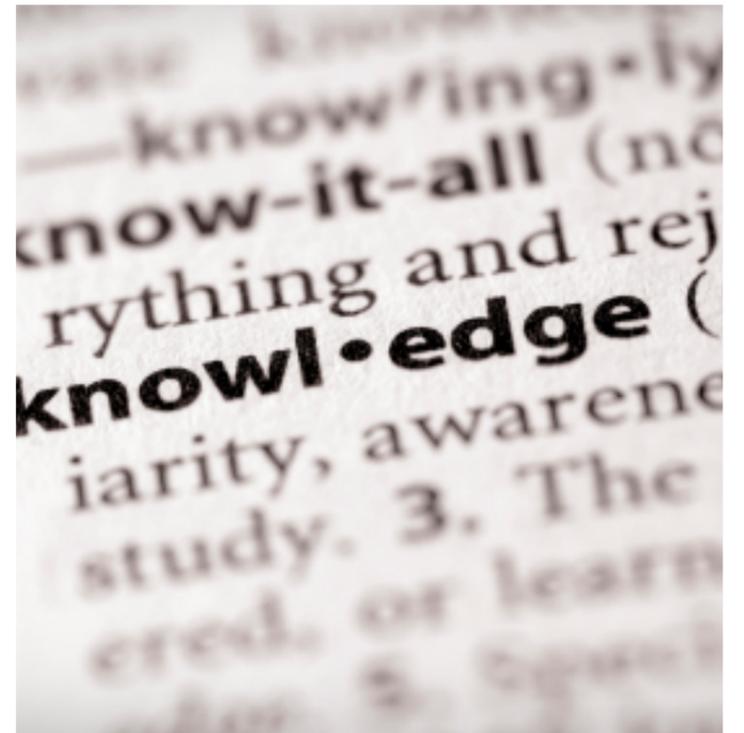
Common patterns only become visible and potentially reliable when we collate and sift through the results of multiple, small, non-randomised research projects undertaken over the past twenty years. In this way we find, for example, that the desire for autonomy is of primary importance to elderly residents of care facilities and this desire is cross-cultural. Although a significant piece of information, for the architect or designer, the question remains: how can design enable a degree of independence for the resident of an aged care facility?

This journal goes beyond abstract findings and broad principles, beyond the “what” and “why” of research into the world of “how” for the design of aged care facilities. Seemingly obvious and widely accepted design principles can become complex in detail and this issue of EBD explores them in terms of available supporting evidence, degrees of certainty and applicability. The journal addresses some of the problems and opportunities associated with existing evidence around the concept of a *causal* relationship between environment and occupant, but will also examine the role of *social* evidence where the preferences and opinions of end-users of aged care environments can be understood and, most importantly, used in the design process.

Finally, we must acknowledge that, regardless of how much we come to know, we always reach the limitations of existing knowledge. If we understand that the gathering of evidence is an evolving process and not a fixed product, then any design response is always, initially hypothetical—pushing the boundaries of what is known in order to learn more. The most important question is, on what is that design hypothesis based? For example, significant and reliable new findings from the field of neurophysiology (about how implicit memory remains intact in persons with dementia) may play a role in non-cognitive wayfinding, but they have yet to be tested through design implementation, occupation and analysis. There is no final answer, but there is a continuous state of improvement.

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“This journal goes beyond abstract findings and broad principles, beyond the ‘what’ and ‘why’ of research into the world of ‘how’ for the design of aged care facilities.”



## Taking a Participatory Design Approach

How should we approach the use of design principles?

In their 1993 book, *Contemporary Environments for People with Dementia*,<sup>9</sup> Uriel Cohen and Kristen Day argued that guidelines for the planning and design of environments for people with dementia “are best viewed not as inflexible directives, but as an attempt to expand and stimulate thinking on the relationships between dementia and design...as hypotheses amenable to, and requiring, implementation and validation.” In 2003 GD Weisman<sup>10</sup> agreed, suggesting that guidelines “might best be viewed as broad hypotheses or notions of best practice...the application of which must be tempered by circumstances specific to individual dementia-care settings.”

This loose academic convention creates a challenge for architects and their clients, who must make design decisions about how architectural environments will, or will not, meet the daily needs and desires of their occupants.

However, over the past twenty years, a degree of predictability has begun to emerge in the research findings on the relationship between environment and occupant—so much so that reliable design strategies have become a possibility. The evidence in this publication is presented not only as facts or rules, but as a series of strategies, scaffolds upon which architectural ideas can be built. For example, our growing knowledge about the nature of “home” and our certainty about the universal importance of dignity and autonomy allows us to focus on the design of legible spaces that can be navigated and manipulated to some degree by those who are mobile enough to do so. We perceive residents with dementia, not as problems to be solved, but as people with varying degrees of capability and we can design suitable environments around that information.

Architects should however be careful not to overstate, or undervalue, the causal impact of empirical evidence in a creative process. As Nancy Mace and Peter Rabins <sup>11</sup> suggest in their book, *The 36-Hour Day*, it is important to remember that, although broad, common patterns emerge over time, no single design suggestion will work in all situations. Different people need different approaches and solutions that work within the limitations of the client system, which has a significant impact on the validity and applicability of the outcomes of any study.

The new challenge is in managing the delivery of an architecture that is designed to evolve while finding ways for clients and occupants to understand and accept that idea. This is where a participatory design approach comes into its own—architects engaged in the design of a nursing home test evidence-based design strategies in creative collaboration with care professionals, residents and their families. Interactive sessions made up of interviews, focus group sessions, in depth discussions and collage-making increase support for the work of architects and helps them reflect on what the end-users really want. <sup>3</sup>

We build a stronger evidence base by iteratively testing our hypotheses through longitudinal post-occupancy analysis and the resulting knowledge helps to improve the original design principles. New design hypotheses spring up and we are constantly rediscovering the evolving edge of our knowledge. The architectural process becomes part of an ongoing research process. Residents become active participants in a design and evaluation team, instead of passive “guinea pigs” on whom new design theory is imposed, but never tested. This also provides an ethical framework for doing non-invasive architectural experiments, and may even provide higher quality evidence which also accounts for applicability and usability in real settings.

Participatory design methods bridge the gap between theory and practice.

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“The new challenge is in managing the delivery of an architecture that is designed to evolve while finding ways for clients and occupants to understand and accept that idea.”

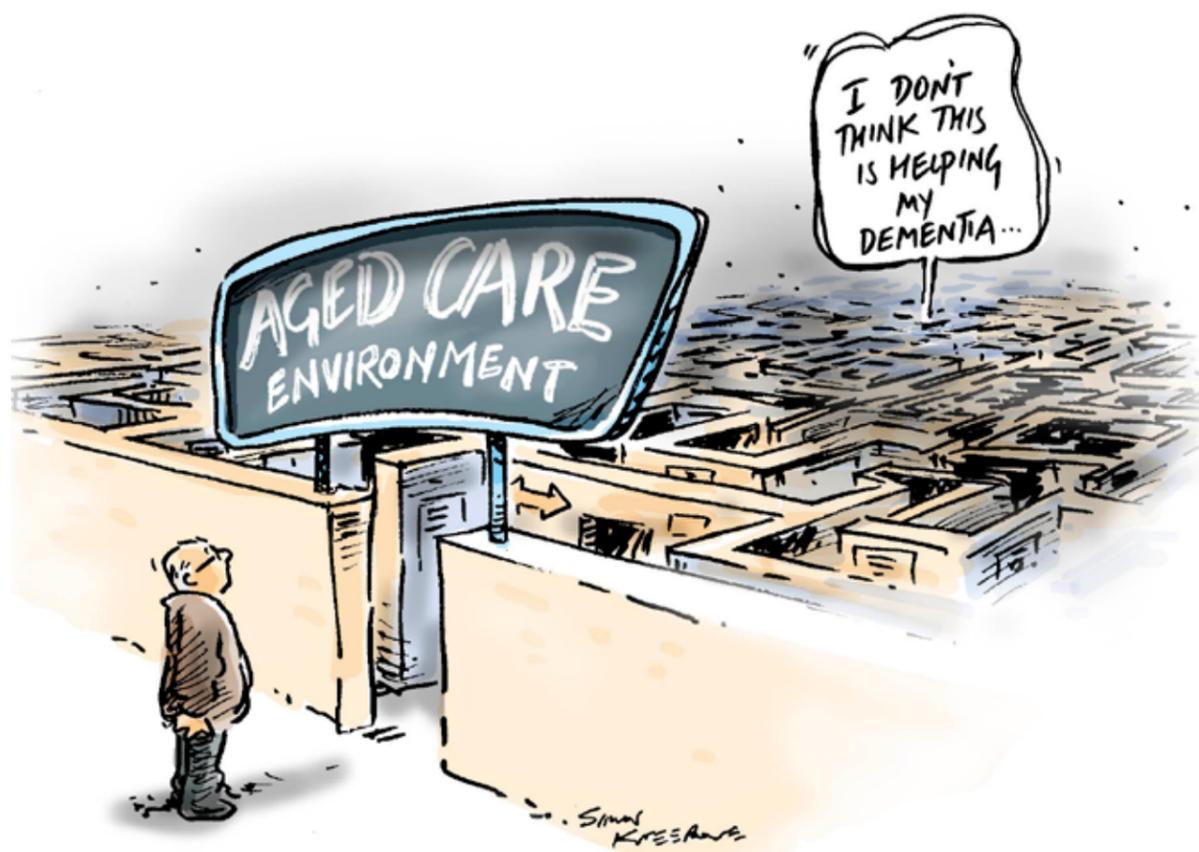


Image: Simon Kneebone

## The future

In 2001, Margaret Lawton <sup>12</sup> argued that the interface of person and environment in real situations may be too complex to capture in a linear experimentally controlled test. Just over a decade later, technological innovations including generative algorithms and sensor-based data collection systems make these complex studies possible. Although easier said than done, these technological innovations hold a great promise for future research and design development. Small non-randomised studies can now be globally coordinated, making it possible to understand local differences in a broader general context. More patterns of commonality begin to emerge.

Perhaps, most importantly, research culture has shifted from a negative focus on solving behavioural problems to a positive focus on the remaining capabilities of persons with dementia. We have become aware just how much of the self is retained within a cognitively impaired person, and how important it is to their sense of well-being. In 1990, Myra Schiff <sup>13</sup> pointed out that there was a focus “on how ‘bad’ environments can hurt, but not on how ‘good’ environments can help.” Twenty-four years later, the reverse is finally becoming true.

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# Design Principles

A close-up, high-contrast photograph of two hands, one wearing a watch and a ring, set against a dark background. The hands are positioned palm-up, with the fingers slightly spread. The lighting is dramatic, highlighting the texture of the skin and the details of the jewelry. The watch is a simple, thin band on the left wrist, and a ring is visible on the ring finger of the right hand. The background is dark and out of focus, emphasizing the hands as the central subject.

## Design Principles

**In the field of gerontology, academic literature frequently identifies 10 principles for good aged-care environments that are suited to those of us with some form of dementia. Needless to say, the set of principles are rarely identical, but they have much in common, and there is much agreement between the researchers involved.**

**In the following pages, the topics have been conflated into 6 primary principles that are repeated across the literature, but EBD has gone one step further. For each principle, you will also find a series of design strategies that were developed as a direct response to the evidence presented in the literature. We want to make the evidence as useful as possible, to those who make design decisions that will affect the everyday lives of others.**



**Design  
Principle 1**

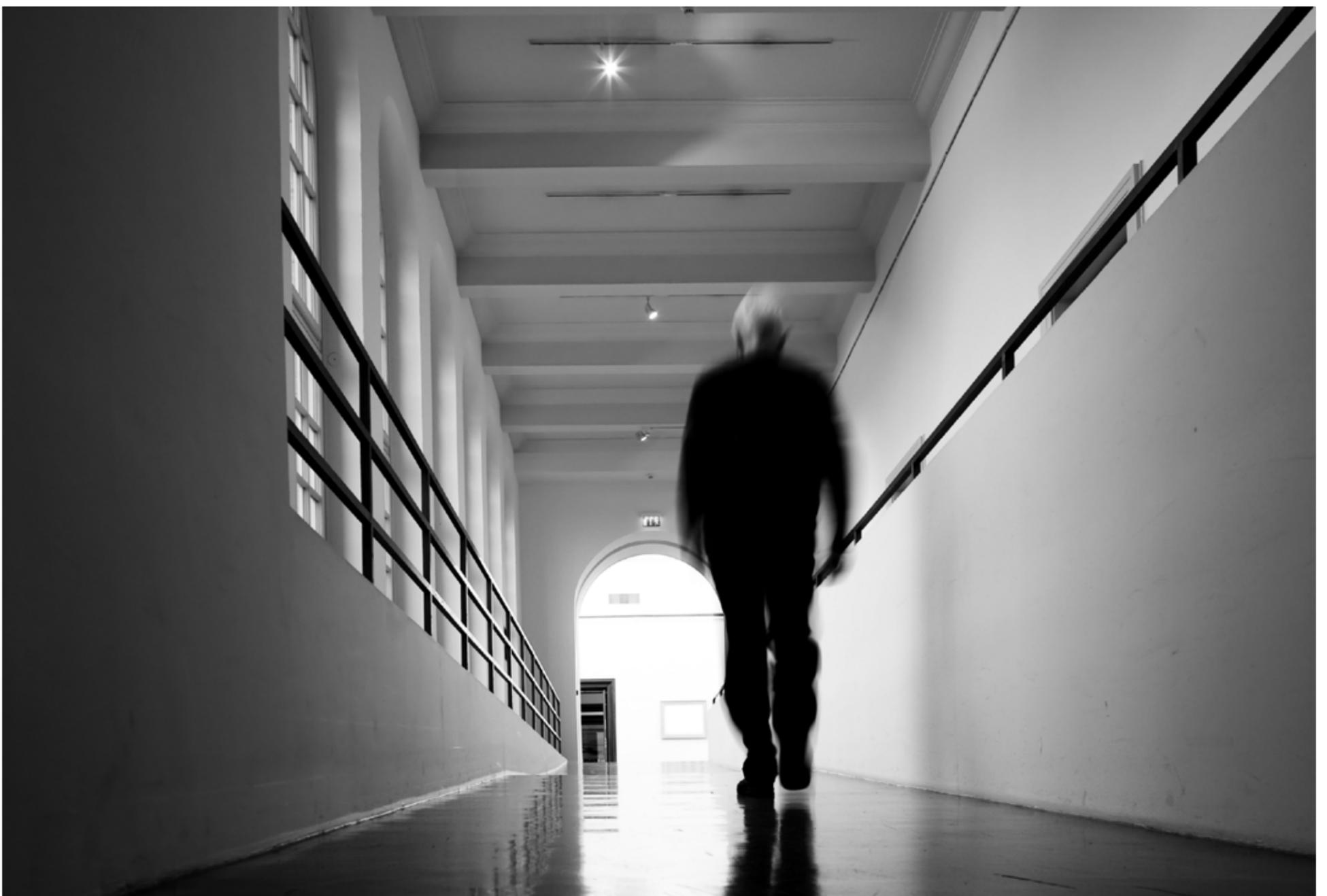
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**Facilitate  
orientation**

**The importance of appropriate wayfinding strategies, designed to suit the needs of residents, cannot be overstated. <sup>1</sup>**

For mobile people with dementia, wayfinding decisions are based on environmental information that is readily accessible, moment-by-moment, as they move along a path. Plan configuration can therefore support or impede orientation, having a significant impact, not only on quality of life for residents but also staff workload and operational costs. Disorientation can create stress leading to agitated and aggressive behavioural responses. Residents who cannot identify paths to desired locations have exhibited anxiety, confusion, mutism and even panic. It is apparent that unique environments are preferable to repetitive ones, however, excessive complexity can also lead to disorientation. <sup>2, 3</sup>



# 1

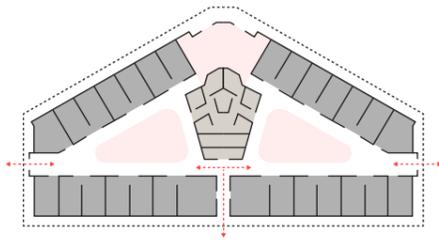


## Design Strategy 1A: Layout

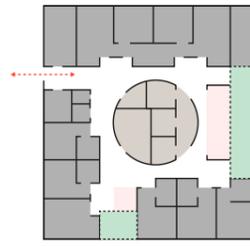
Create a simple network of differentiated but visually connected spaces. Smaller, open plan, *cluster* layouts are best suited to dementia care units—they provide mobile residents with a direct line of sight from their bedroom door to adjoining destinations such as dining, living and outdoor spaces. Shared social spaces may not have to be fully contained and can be integrated with access to walking paths, private nodes and outdoor areas.

# A

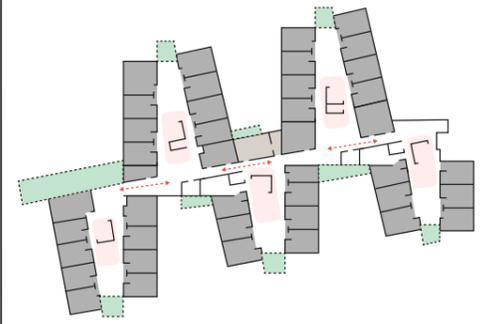
### Clustered Layouts:



Corrine Dolan Center, Ohio 1991

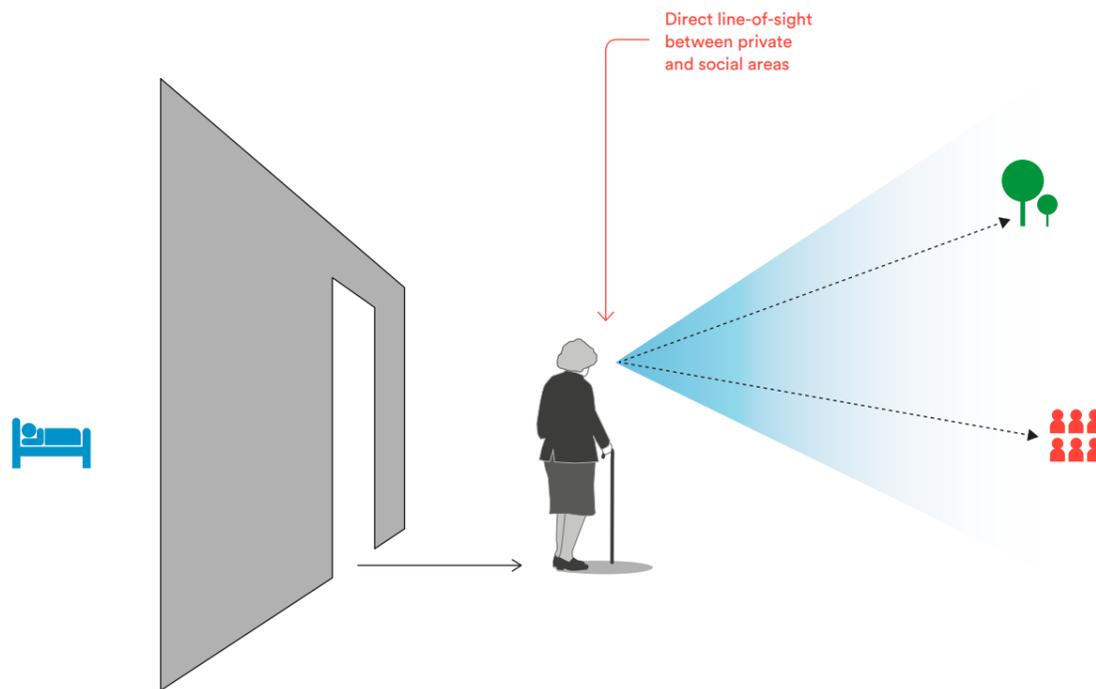


Nuremberg, Germany 2006



Virranranta, Finland 1992

### Line-of-sight



### Legend

- Bedrooms
- Social Spaces
- Staff Facilities
- Outdoor/Garden
- > Controlled Exits

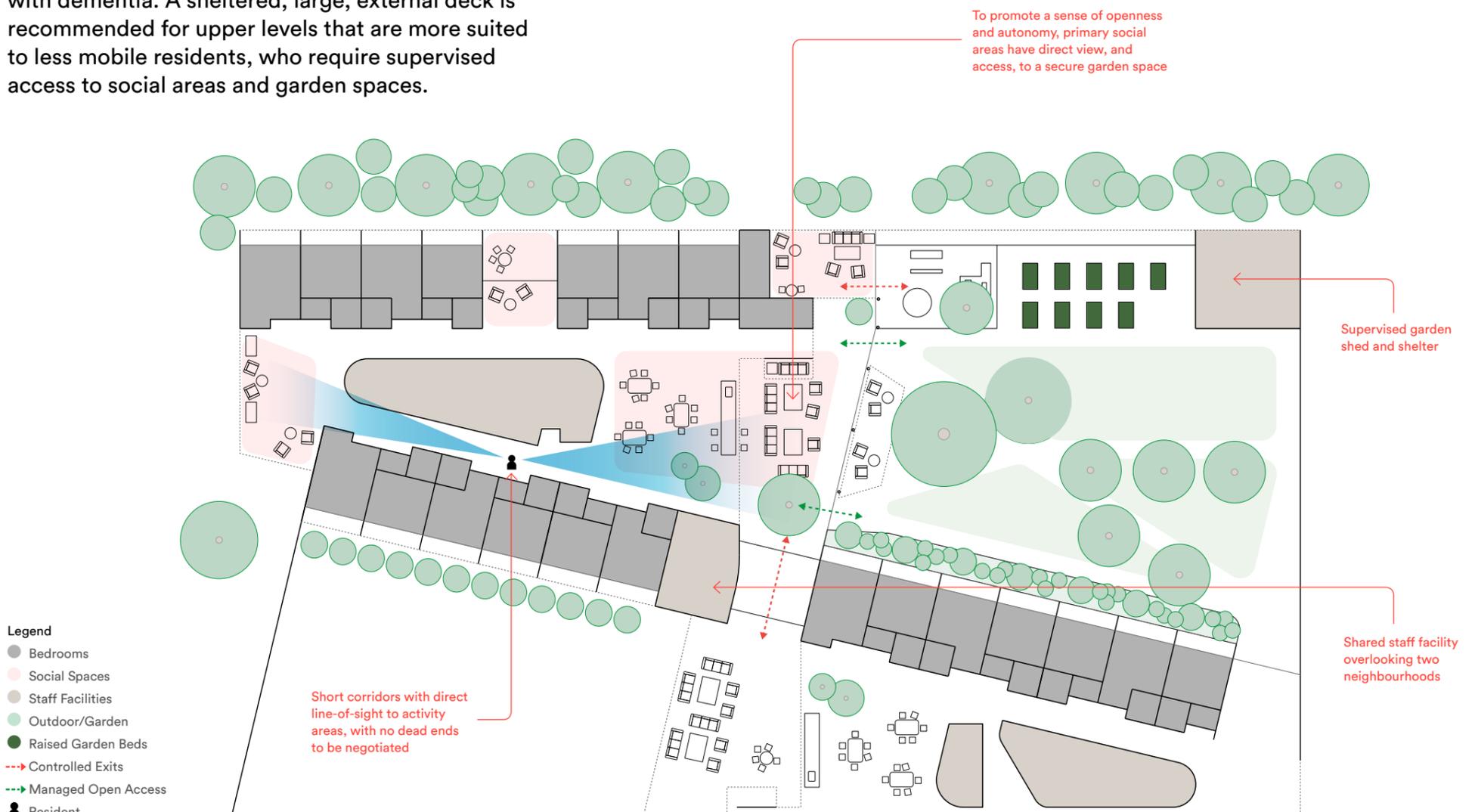
The tendency to become lost is shared by almost all patients with Alzheimer's Disease (93%), however this is not just related to memory impairment, it reflects an inability to consciously link recognised scenes with locations in the environment. <sup>4</sup>

Smaller, open plan, "cluster" layouts can produce higher levels of orientation and reduced behavioural disturbances than larger "communal" facilities. <sup>5, 6</sup>

## Prototype Plan: Dementia Care Unit

Neighbourhood model: 12–15 beds arranged around social and staff areas. Suited to mobile residents with dementia. A sheltered, large, external deck is recommended for upper levels that are more suited to less mobile residents, who require supervised access to social areas and garden spaces.

# G

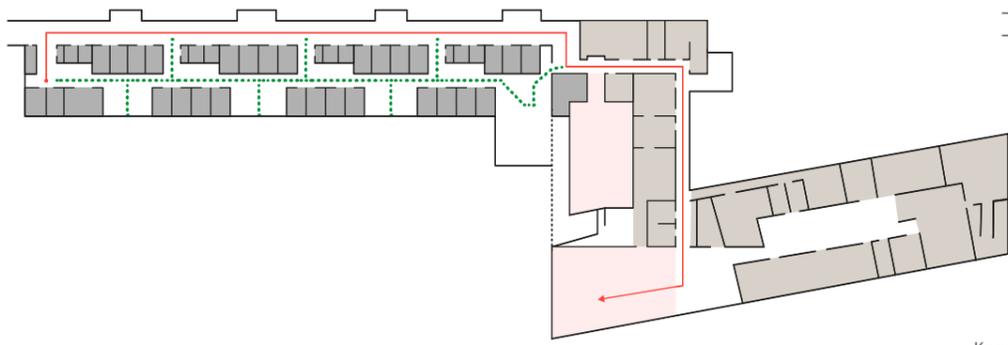


## Design Strategy 1B: Corridors

Where short corridors are necessary, minimise the need for direction changes that require a series of connected, cognitive decisions to be made. Ensure that potential destinations are visible and, where possible, attention is attracted in one direction only. If two directions are required then avoid dead end corridors.

### Disorientation:

- Legend
- Bedrooms
  - Social Spaces
  - Staff Facilities
  - Resident path
  - ⋯ Alternate path



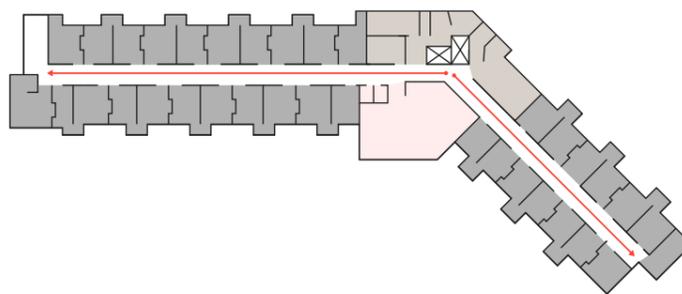
- 27 Doors
- 6 Alternate Passageways
- 6 Turns
- 0 Distinguishing landmarks

Kenyuen Home, Japan 2001

### Disorientation:

Emerging from the lift a resident is presented with two competing corridors that make orientation extremely difficult.

- Legend
- Bedrooms
  - Social Spaces
  - Staff Facilities
  - Resident path



- Long corridors
- Undifferentiated rooms
- Equal choice on emerging from lift

Passini, 2000

Long corridor layouts have been associated with higher degrees of disorientation, restlessness and motor dysfunction and with reduced vitality and identity.<sup>3, 7</sup>

**Wandering can be a means of communicating needs unable to be articulated “normally” because of cognitive decline.<sup>8</sup>**

Although wandering behaviour increases with the severity of cognitive impairment, good orientation can make a useful contribution to effective care strategies.<sup>9</sup> People with dementia may not be capable of constructing internal wayfinding sequences, but new research indicates that, in many cases, their implicit memory<sup>10</sup> remains intact. Repetitive exposure to specific routes and their unique markers (objects that go unnoticed), can potentially be used to differentiate one route from another.<sup>11, 12, 13, 14</sup>

# B

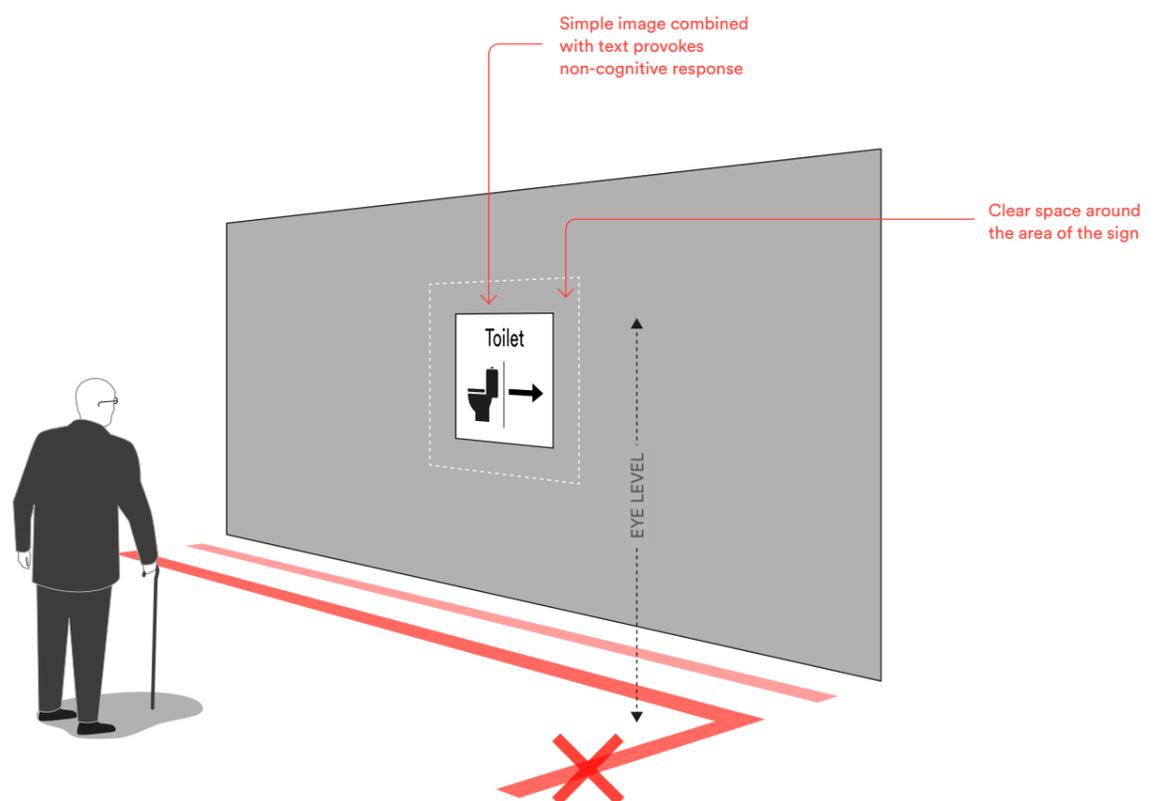
## Design Strategy 1C: Signage

Provide written signage, combined with images, to identify destinations, rather than signs using only symbols, artefacts or colour coding. Taking into account that although the use of individual symbols may not facilitate meaningful recognition, they can be useful as a way of differentiating one route or space from another.

(Refer to Strategy F)

### Signage on walls not floors

Colour-coded lines require meaning to be constructed by residents who may be unable to create wayfinding mind-maps. However colour can be used for non-cognitive “priming”. Refer to principle 1F.



✗ Floor lines are ineffective as an orientation tool and can be perceived as an obstacle/trip hazard

The use of written signage can be effective as a wayfinding tool. In addition, residents can retain the ability to recognise photographs of themselves but not others.<sup>15</sup>

However, the effectiveness of symbols, personal artifacts and colour coding of walls and floors, to facilitate wayfinding, is strongly debated, and has not been adequately substantiated empirically.<sup>3</sup>

# C

Day Care Centre, Barcelona  
—  
Architects:

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Local materials, regular events and a specific, parkside location, combine to create a place of focus for the elderly members of this Barcelona community.

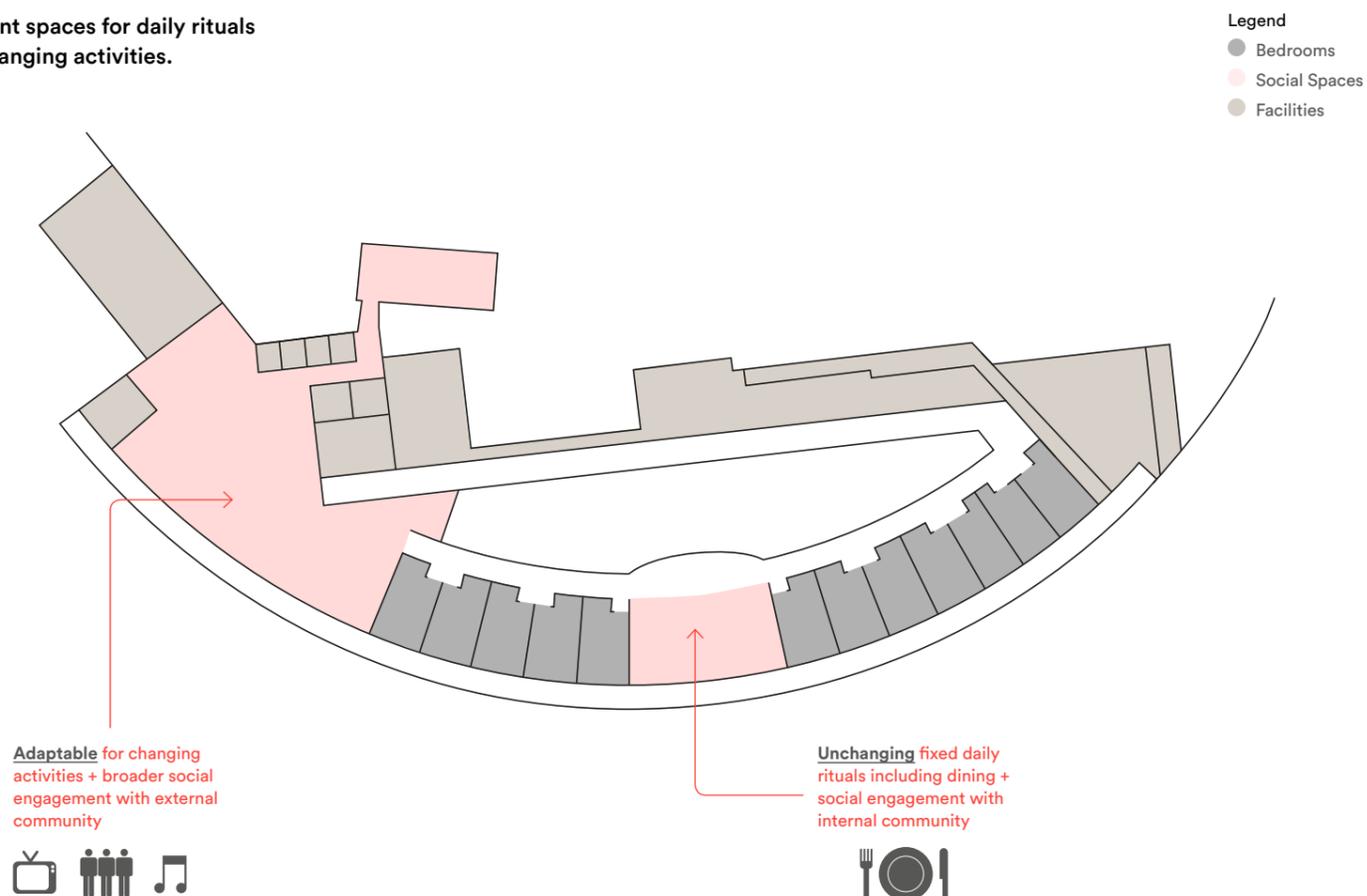


Image: © Carlos Climent

## Design Strategy 1D: Familiarity

Spaces intended for daily rituals: eating, socialising etc should be predictable to the resident. Such spaces should remain unchanged and not be located in multi-purpose areas that may be designed specifically for changing events, activities etc.

Different spaces for daily rituals and changing activities.



Montemurlo, Prato

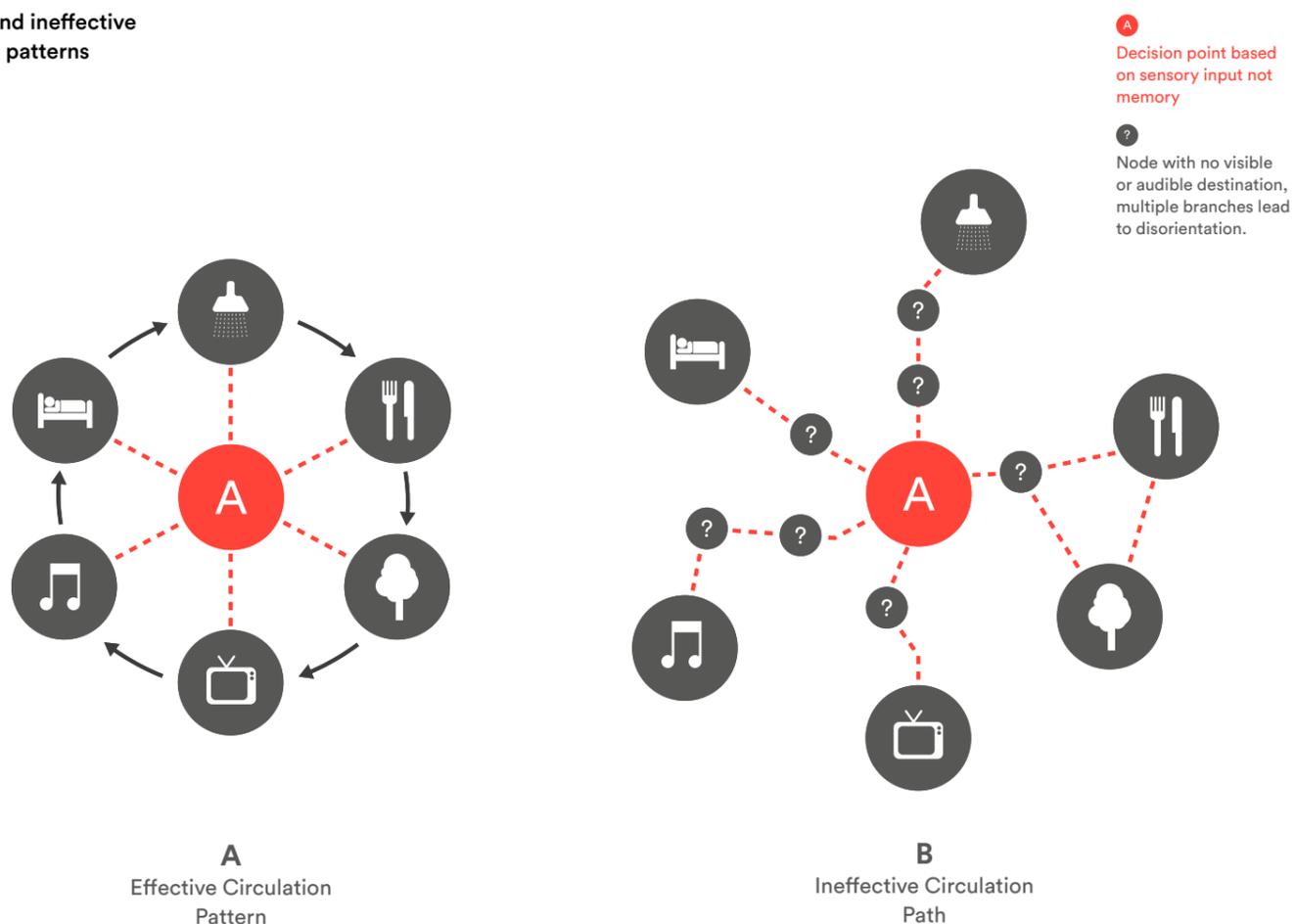
Consistency can be important to many residents. If a familiar activity is relocated, or a familiar space is used for another function this can lead to anxiety and agitated behaviour. Negative resident reactions have been associated with unfamiliar spaces, equipment or procedures.<sup>16</sup>

# D

## Design Strategy 1E: Circulation

Where possible, circulation systems should be in the form of short, continuous loops that connect bedrooms and social spaces, with a variety of multi-sensory nodes and large external windows along the way. The intention is that residents are not faced with the need for decisions that require recall from an internal “map” of their environment. As a general guide, avoid monotonous repetition or excessive complexity in the design of circulation systems.

Effective and ineffective circulation patterns



Monotonous environments make wayfinding more difficult. Labyrinths and symmetrical layouts are disorientating because of their repeated sameness. In addition, floor patterns and dark lines or surfaces can disorient the residents and cause anxiety.<sup>3</sup>

Walking paths punctuated with multi-sensory nodes have been shown to decrease exit seeking, improve mood and engage family members.<sup>17</sup>

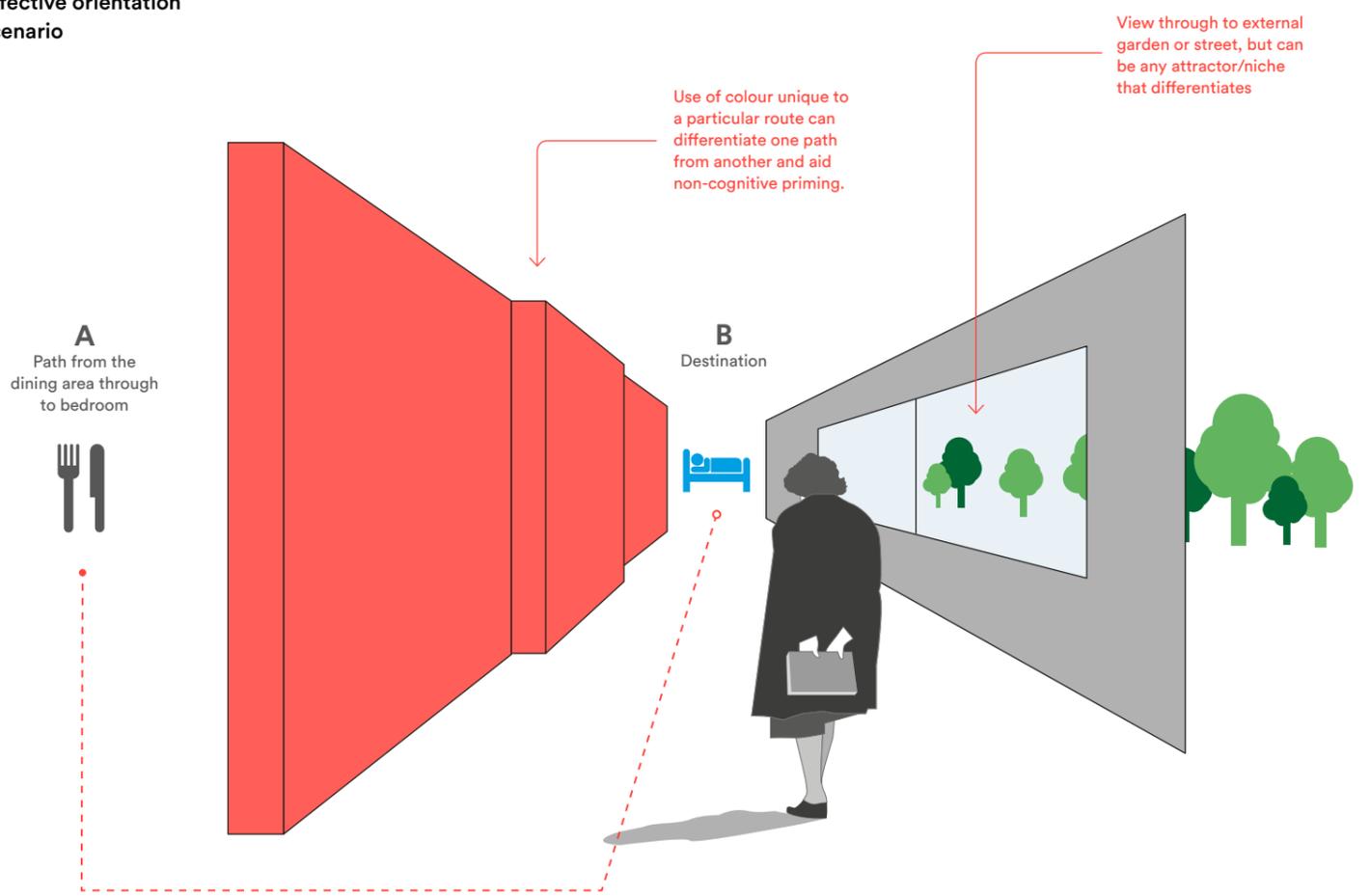
The use of large external windows can facilitate both non-cognitive and seasonal orientation.<sup>18</sup>

# E

## Design Strategy 1F: Priming

It is hypothesised that orientation strategies based on implicit not explicit memory, <sup>10</sup> can potentially enable residents to move between destinations, without having to think about how to get from one place to another. Priming is defined as the use of repetitive stimuli to produce a non-cognitive response. Strategies could include the use of short, looping circulation paths, a unique sequence of unobtrusive route identifiers and nodes with clear lines of sight to the next destination.

### Effective orientation scenario



For frequently travelled routes, wayfinding relies on cognitive abilities beyond explicit memory. <sup>19</sup>

Residents with Alzheimer's disease, with medial-temporal lobe damage, can retain their implicit memory <sup>10, 20</sup> for object information relevant for navigation. <sup>21, 22, 14</sup>

However, those residents with dementia with Lewy bodies continue to perform poorly in orientation tests. <sup>23</sup>

# F

## Design Strategy 1G: Light and sound

Provide adjustable lighting zones to allow flexibility in lighting levels based on the needs. (Refer to principle 4D for more detailed information) Reduce reverberation time through the use of absorptive materials.

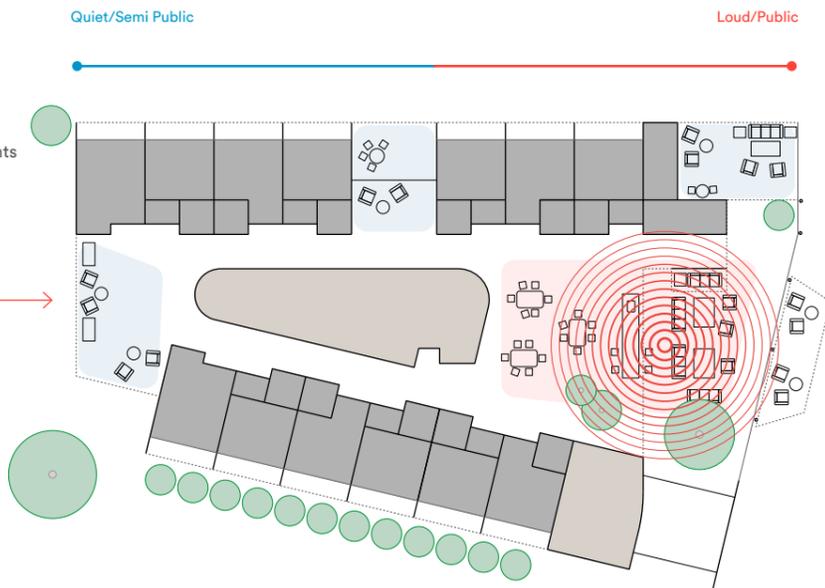
### Sound

The scale of individual social spaces can have a significant impact on noise levels. In addition to main social areas, provide free access to alternative "niche" spaces, for residents to "self-select" levels of sensory stimulation.

Smaller niche creates very quiet social spaces

#### Legend

- Bedrooms
- Quiet Social Spaces
- Loud Social Spaces

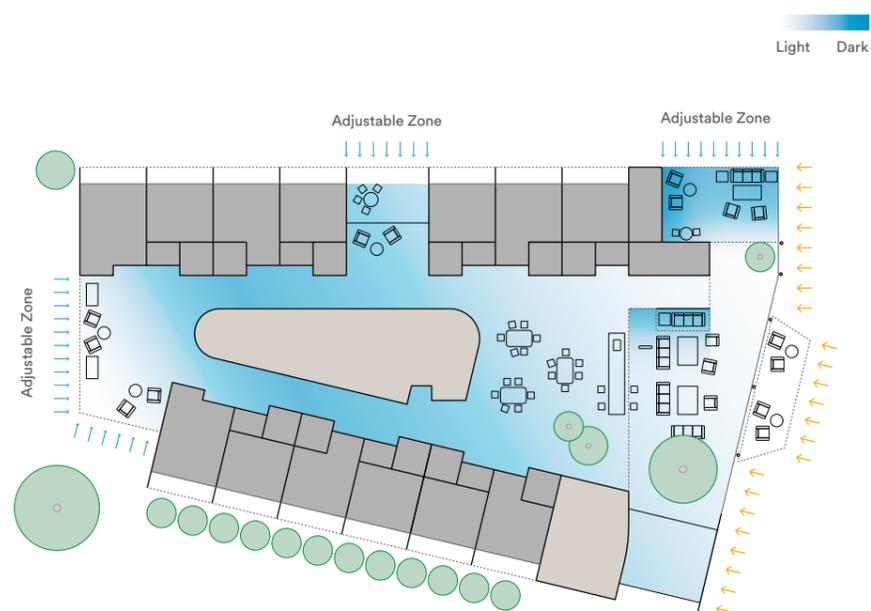


### Light

In larger social areas, residents can choose between areas of differing light qualities. In smaller social areas and bedrooms, residents have the ability to adjust the amount of direct or indirect light present within certain spaces (Adjustable Zones).

#### Legend

- Bedrooms
- Quiet Social Spaces
- Loud Social Spaces



Quiet environments have also been associated with diminished levels of agitation. <sup>16</sup> In Netten's 1993 study of 79 dementia residents at 13 long-term care facilities, higher levels of orientation were associated with quiet environments. Researchers theorised that disorientation followed residents' attempts to "shut out" noisy environments. <sup>16</sup>

Wayfinding among residents can be less successful in facilities with low lighting levels in public areas. <sup>16</sup>

# G

## Design Principle 2

### Promote independent functioning

The ability to function independently has been connected to improved sense of self and of wellbeing among residents of aged care facilities. <sup>1, 2, 3</sup>

Identity is viewed as something which may be “socially established or socially expressed”. How people with dementia experience themselves and their surroundings, even in late stages, has implications for how they cope with the illness, how they relate to others and how they might respond to different types of intervention. <sup>4</sup>

The importance of attributing personhood to individuals with dementia, irrespective of cognitive status or degree of overt responsiveness, is now widely accepted. <sup>4</sup>

The ability to choose where to sit, what to do and who to look at is also intrinsically connected to a stronger sense of self and the concept of belonging. “Out of the way” spaces that cannot be “discovered” easily tend not to be used, even in smaller, clustered layouts—an idea that can be used in multiple ways, to support social connection or to create semi-private zones within more open social areas.



# 2



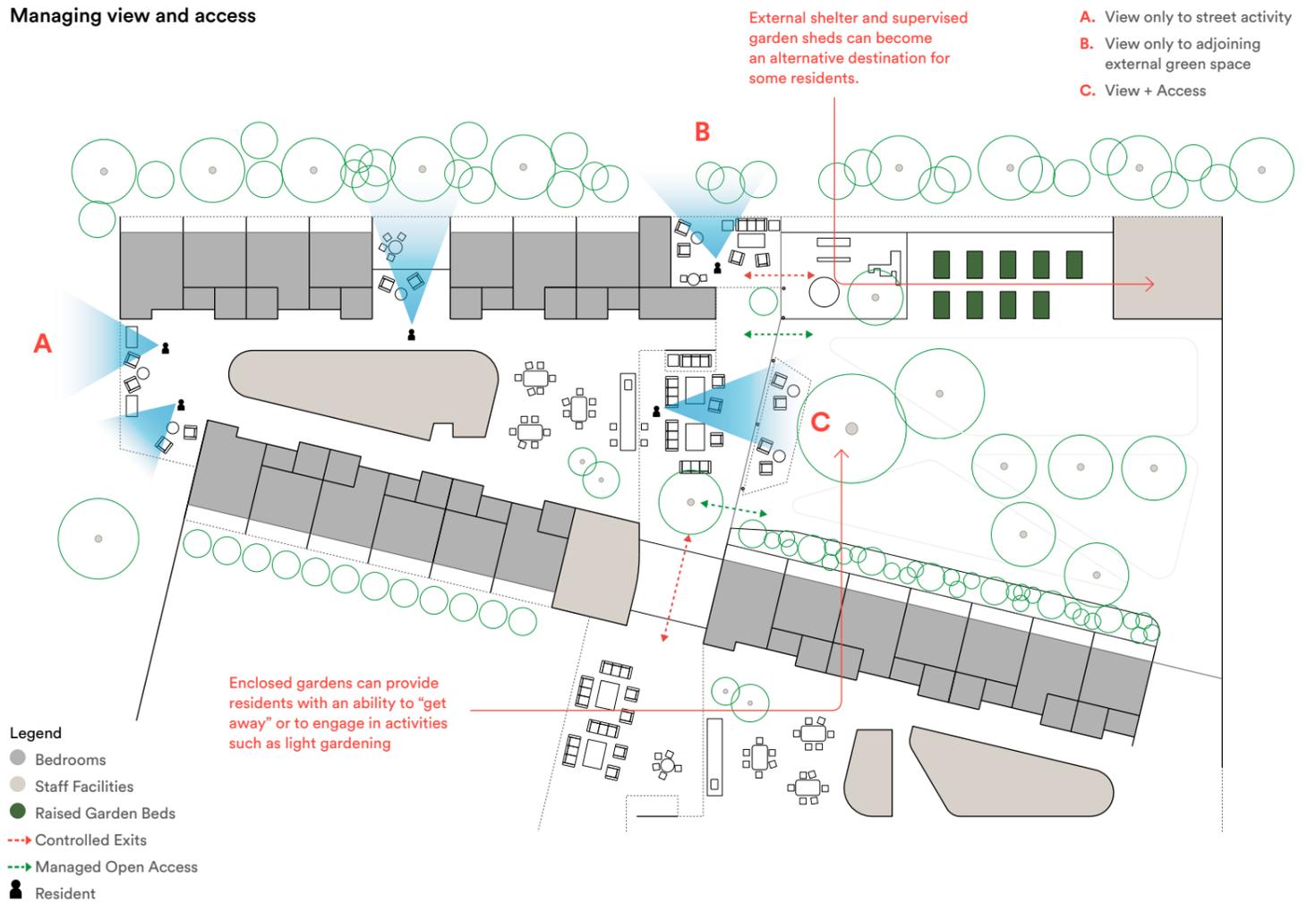
## Design Strategy 2A: Autonomy

Provide mobile residents with the ability to move around safely and freely within their unit and, where possible, allow unrestricted access to a secure and safe external areas.

Attractors along a multi-sensory path can be a series of unique stopping or sitting areas, of different scales, with views to a variety of active or passive external spaces.

Spaces with varying degrees of social connection, allow residents to choose the place that best suits their particular need state as they move.

### Managing view and access



Residents of aged care facilities connect their quality of life with the degree of control they had over their environment and ability to "feel free to do things".<sup>5</sup>

In a review of 34 separate studies, from across the globe, loss of self-esteem, autonomy

and usefulness were found to be of primary concern to people with dementia.<sup>5</sup>

A separate study of 231 family members across six care facilities in Canada, found that families related independence and dignity, ranking them as the

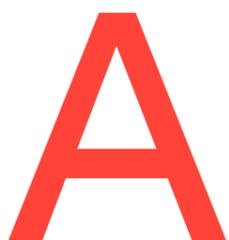
second most important priorities for their relative's care, behind health and safety.<sup>6</sup>

Even with dementia, residents will continue to modify their environment to meet their needs. Residents at Woodside Place RCF in the US, (Oakmont,

Pennsylvania) were found to repeatedly move chairs from the centre of a large room to line the perimeter wall until staff stopped relocating them.<sup>7</sup>

**Our sense of self is intrinsically bound up in our ability to act and that need remains intact for people with dementia.<sup>8</sup>**

Agitation results from a resident's interactions with the environment or their internal state, giving rise to unmet needs that attentive care can treat. A resident's ability to make limited choices will go some way towards meeting those needs caused by environmental interactions.<sup>8</sup>



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Residents of aged care facilities connect their quality of life with the degree of control they have over their environment and their “freedom to do things”. <sup>5</sup>



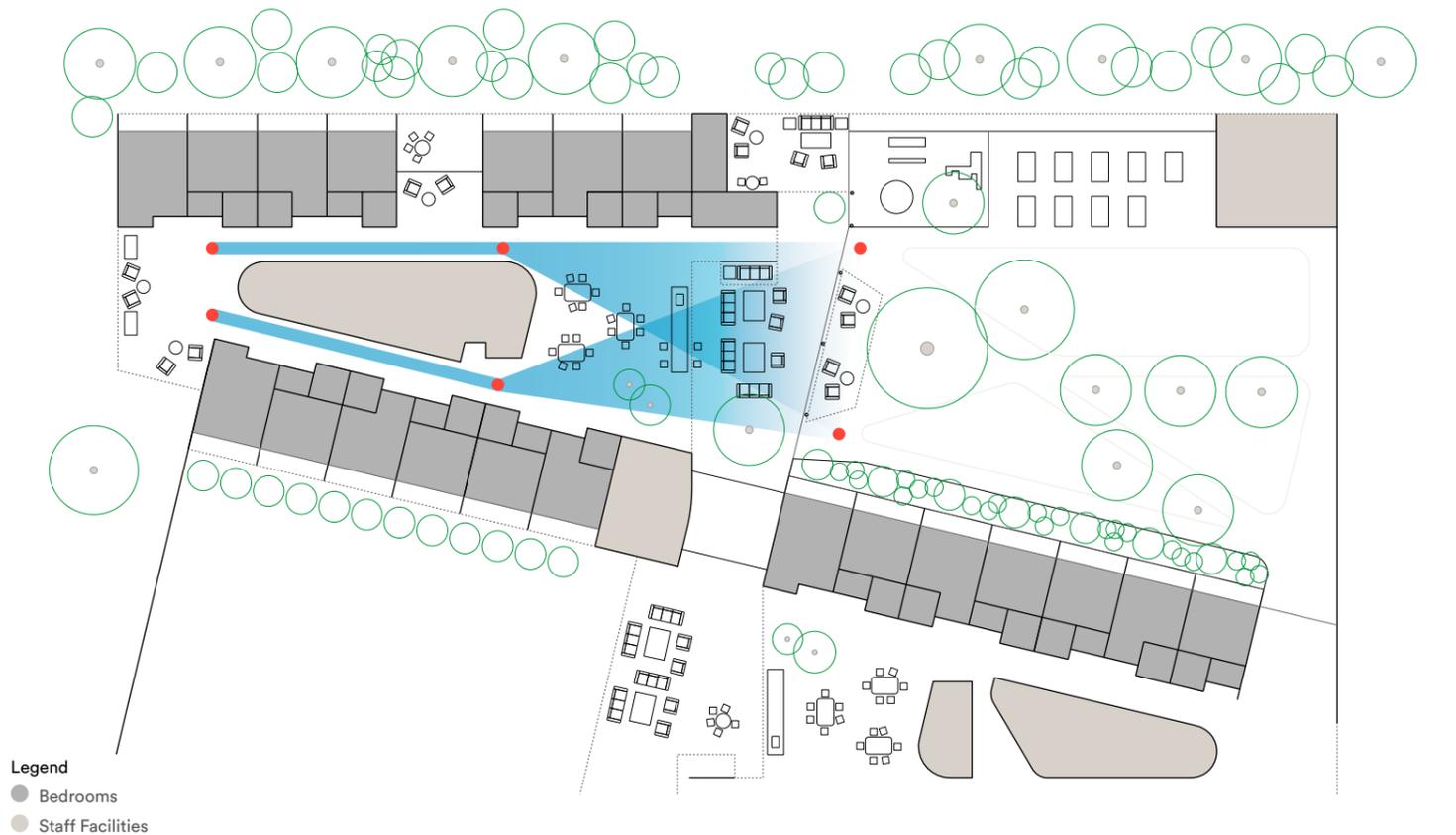
## Design Strategy 2B: Legibility

Provide visual and functional cues that will allow a resident with fluctuating levels of lucidity to understand where they find themselves, as they become intermittently aware, and make decisions accordingly.

Avoid complex signage and visual overload from notice boards that demand attention. In addition to signage, cues can be a view—even a glimpse—sound or smell of a potential destination.

Allow for “pause” points where residents can observe primary social spaces before entering.

### Visual cues that assist wayfinding



Fluctuating cognition and attention can occur in 90% of residents with dementia with Lewy bodies, in 20% of residents with Alzheimer's disease and in 30% to 50% of residents with vascular dementia, ranging from episodes of lucidity to reduced awareness and even stupor.<sup>9</sup>

Environments where ambient sensory input is more understandable have been shown to reduce anxiety, agitation and verbal aggression caused by disorientation.<sup>10</sup>

# B

## Design Strategy 2C: Mobility

Where possible, design circulation paths as multi-sensory wandering loops that enable residents to meet their need to move, as it occurs. Increased levels of independent activity can reduce the need for staff to retrieve residents from a dead end or complex corridor system.

### Multi-sensory wandering loops



Walking can bring physical and psychological benefits, but people with dementia also walk in response to internal impulses.<sup>11</sup> Wandering is now understood as a reflexive response intended to relieve anxiety and confusion.<sup>12</sup>

Walking, exercise or daily structured routines have been associated with reduced wandering, or improvement in agitation and walking paths with multisensory activity nodes have been shown to decrease exit seeking, improve mood, and engage family members.<sup>13, 14</sup>

# C

## Design Strategy 2D: Physical support

Tables 1, 2 and 3 on the following pages cover a series of detailed recommendations for physical support, safety and security of residents with dementia. Activities include: toileting, bathing, personal care, dressing, sleeping, cooking and dining.

These tables have been adapted from a van Hoof et al (2010)<sup>15</sup> where the reader will find a more detailed set of recommendations.

### 1. Toileting, bathing and personal care

Issues	Environmental Intervention	Comments	
Spatial disorientation and/or perceptual deficits	Visual cues: illuminated sign at restroom door.	Image and text combination works best. Not suitable or useful for people with severe dementia.	
	Coloured toilet seats and line around toilet bowl. (fig.01)	Contrast allows toilet to be more easily located.	
	Avoid use of high-contrast lines, patterns or mats on the floor.	Can be perceived as holes or obstacles on the floor, causing avoidance behaviour and a potential fall.	
	Remove waste baskets, hampers and other items resembling toilet bowls.	Can be effective if these items are being confused with the toilet.	
	Do not use glass or projecting shelves and make shelf surface high contrast to walls.	Projecting shelves can cause significant harm in the event of a fall.	
	Reduced mobility, balance and coordination	Raised toilet seat.	Raise by up to 8cm.
		Grab bars on shower wall, beside toilet, in front of sink, or integrated into the vanity. (fig.02)	For support due to tiredness or dizziness. Grab bars should be highly visible.
		Replace any towel rails with grab bars.	Person may continue to use the unsafe toilet paper holder/towel rack to hold on to.
		Automated toilet with bidet.	Incorporates automatic flusher, warm-water bidet, hot air drying (can be installed on a standard toilet bowl). May cause fear in residents with dementia.
		Non-slip floor covering.	Ensure matt or low-sheen finish to avoid perception of water on the floor.
Provide one-handed faucet with a large handle. (fig.03)		Easier for caregiver to operate.	
Reduced judgement and need for protection	Lower temperature of water heater.	To prevent burns. Not lower than 60°C to 65°C to prevent the growth of Legionella.	
	Temperature limiting (anti-scalding) balancing valve on taps.	To prevent burns.	
	Remove lock plug sockets and avoid use of electronics.	To prevent electrocution.	
	Label taps hot and cold.	Use clearly visible colours.	

### Products

fig.01

Adapted version of HEWI washbasin. Image © Dr Birgit Dietz.



fig.02

New research has found the delineation of the toilet bowl and sink to be very effective in helping people with dementia to function. Image © Dr Birgit Dietz.



fig.03

In a recent test, the single lever (C) faucet was most easily used by people with dementia. The dual handle (A) was the most easily recognised and the electronic faucet (B) gave rise to uncertainty, aggression and anxiety. In some cases the participants attempted to destroy the faucet out of frustration.



A. Dual handle



B. Automatic sensor



C. Single lever

# D

## Design Strategy 2D: Physical support continued

### 2. Dressing and sleeping

Issues	Environmental Intervention	Comments
Confusion	Provide a place to store clothes out of reach from the person with dementia.	In the event that the person puts on multiple layers when not required.
	Place two wardrobes, one obvious and one hidden, with the obvious wardrobe containing only one or two sets of clothes.	To limit problems that arise from having too many options to choose from. Also allows for separation of seasonally inappropriate clothes.
	Minimise places to hide items such as wastebaskets.	In case of hoarding and/or use as a toilet.
Reduced judgement and need for protection	Minimise use of bedrails if person with dementia is highly mobile. If necessary lower the bed or place the mattress on the floor.	Bedrails account for a significant amount of injury due to night time falls among mobile people with dementia. A mattress on the floor can make getting up virtually impossible, but a person can roll out and get cold.
	Move the bed against a wall.	Provides protection from falls on one side of the bed.
	Soft floor covering.	Potentially reduces the extent of injury in the event of a fall.
	Sensor lights to illuminate the floor on the way to the bathroom, and at the bathroom itself.	For highly mobile people with dementia who will use the bathroom at night. Sensor lights may disturb some people with high levels of dementia.
	Use bed sensors to manage incontinence, monitor respiration levels and identify when a person is out of bed.	A useful tool for care planning and harm minimisation.
	It should be possible to make the room completely dark through use of automatic lighting and blinds.	Allow the resident to use a simple, secure, bedside control unit for as long as they are capable—after which time the unit can be moved from beside the bed.

**NOTE:** The ability to participate in daily rituals can be of significant benefit to people with dementia and can reduce behavioural problems. There is a need to weigh these benefits against potential safety concerns for an individual or their impact on others.

### 3. Domestic activities

Issues	Environmental Intervention	Comments
Perception and physical deficits	Create deep counters and minimise clutter. Counter height can be variable for wheelchair users.	A lower counter also allows a person with dementia to sit, participate and observe others.
	Store heavy and most often used items at a convenient height.	Minimise bending and stooping. The highest storage shelf should be at a maximum of 1.4 to 1.7m
	Cooktop should be level with the countertop and fitted with crash barrier to prevent pans from slipping off.	Provide a safety cover for the cooktop when not in use.
	Use large, easy to grab handles for drawers. Use open shelves or cupboards	For objects that do not pose a risk to others if thrown or dropped.
	Provide a high-contrast grab bar in front of the sink and a single-control faucet.	Where possible, coordinate all grab bars to be the same colour as this will assist with priming, even for residents with dementia.
Reduced judgement and need for protection	Provide hidden safety switches on gas stove to disconnect burners. Use automatic shut-off or timers for stove and kitchen equipment.	Turns stove off automatically. Timers can be used to prevent use of kitchen appliances after certain times.
	Minimise shelving units over and under work surfaces.	Avoids accidents caused by dropping items.
	Decrease use, or store away, dangerous items, spare items or heavy but throwable objects. Also remove small, ingestible items and potentially poisonous plants.	Items such as knives, scissors, letter/bottle/can openers, pincers, cans, bottle, fireplace equipment, and cutlery, particularly in case of extreme agitation. Electrical equipment, mixers, kitchen machines. Dices, pet food, plastic fruits, fruit-shaped refrigerator magnets. Poisons, plant earth and hydroculture clay.
	Provide two lockable cabinets: one for food and equipment that needs supervision and the other for cleaning products.	Tea and coffee making facilities should also be stored behind a childproof lock.
	In the eating area, avoid placemats, tablecloths, dishes with confusing patterns and prints. Plates, cups and cutlery should contrast with the table surface.	Printed images can be confused for edible items.

In a significant study published in 2010, van Hoof et al report on a range of environmental interventions to support individuals with dementia. The study makes use of the WHO's *International Classification of Functioning, Disability and Health (ICF) (2001)*. Further data were gathered through literature review and qualitative interviews. <sup>15</sup>



## Design Strategy 2E: Sensor technologies

Emerging sensor-based technologies can provide information about a resident's location and wellbeing, while also automatically operating doors, lifts, lights and air condition based on pre-determined preferences and settings.

Many people with dementia, and their relatives, are extremely concerned about how their care might also reduce their freedom of movement and activity levels. For some, these technologies removes locked doors, providing at least a sense of freedom, combined with a sense of security that comes from a level of remote observation. For others, this technology can play a role in managing undesirable behaviour by limiting their access to other residents and environments that may be of danger to them.

A resident's ability to move more, or less, freely through a care facility can potentially be tailored to their individual cognitive capabilities and their social behavior patterns.

From a design and operational perspective, future care facilities will be more open, but controlled in strategic locations. It is important to ensure the building facilities (doors, lighting, AC etc.) and operating systems are sufficiently flexible to be upgraded as new technologies emerge.

### Tracking technologies in dementia care environments



People in early stages of dementia are concerned about the growing lack of autonomy that they often mentally associate with the diagnosis. In these cases, tracking technologies may function as cognitive orthotics to prolong independence at the setting of their choice. <sup>4, 5, 6</sup>

In one study, the elderly participants perceived tracking technology as a way to maintain personal control and they were less concerned about personal privacy. They believed the technology would give them a sense of freedom gained through increased personal safety. <sup>16</sup>

WiFi-based and Global Positioning Systems (GPS) can be used to monitor residents allowing them to move more freely while maintaining levels of safety. Although there are concerns about invasion of privacy, one study found that GPS can provide caregivers with peace of mind while promoting the sense of an independent existence. <sup>17</sup>

Elderly test users of robotic technology have also been found to participate enthusiastically, in order to resist the stereotype of elderly people as being technophobic. <sup>18</sup>

#### Wearable Device



1



#### Receiver/Transmitter



2



#### Information Dashboards



3



**While passive monitoring may be beneficial for people with dementia, often the decision for this intense monitoring is made by a relative or friend who has decisional authority. The use of these technologies calls for effective Advance Care Planning that ideally includes the person while at the early stages of the disease, perhaps even before they become a resident of a care facility.**

New passive monitoring systems will include wearable devices, receivers and mobile, graphic information tools for care providers to instantly assess the condition of a resident, even when they are out of site.

Note: refer to the article by George Demiris on "Smart Homes" of this journal

Example Left: Care Predict™ system

E

## Design Principle 3

### Provide appropriate intellectual and sensory stimulation

Dementia renders a person excessively reactive to minor environmental stimuli that an unimpaired person would ignore. However, the positive impact of stimulating engagement with meaningful activities has also been widely studied and reported.<sup>1</sup> The challenge is to design tasks and environments that reduce stressful demands while meeting the residents' competing need for stimulation and involvement.

Moderate sensory stimulation can promote engagement in activities and can minimise withdrawal among people with dementia. Recent research has also shown that environment, particularly sound, has a measurable impact on pleasure for residents.<sup>2, 3</sup> It is conceivable that environmental qualities such as light, volume, movement and smell could also stimulate a sense of pleasure, but, to date, little or no detailed research has been carried out.

Nevertheless, we know that people with dementia face difficulties with sensory overstimulation that may increase the distraction, agitation, and confusion associated with the disease. At the same time, sensory deprivation has been identified as a potential problem in many dementia care environments. The key is to maintain a balance such that residents suffer neither /from environmental overstimulation nor from sensory deprivation.<sup>4</sup>



# 3



Image: © Offset.com/DreamPictures/Pam Ostrow/Blend

## Design Strategy 3A: Curiosity

Although intellectual curiosity is impaired in people with dementia, emotional curiosity can still be stimulated, potentially by allowing space, light and sound to flow, increase and diminish, from one space to another.

Visual and spatial flow



### Capabilities:

Although novelty-seeking behaviours are reduced, emotional curiosity can still be aroused through sensory stimuli.<sup>5</sup> Until quite recently, care facilities have primarily concentrated on physical more than emotional,

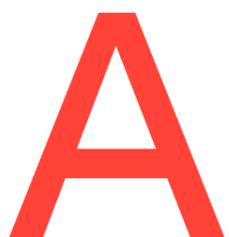
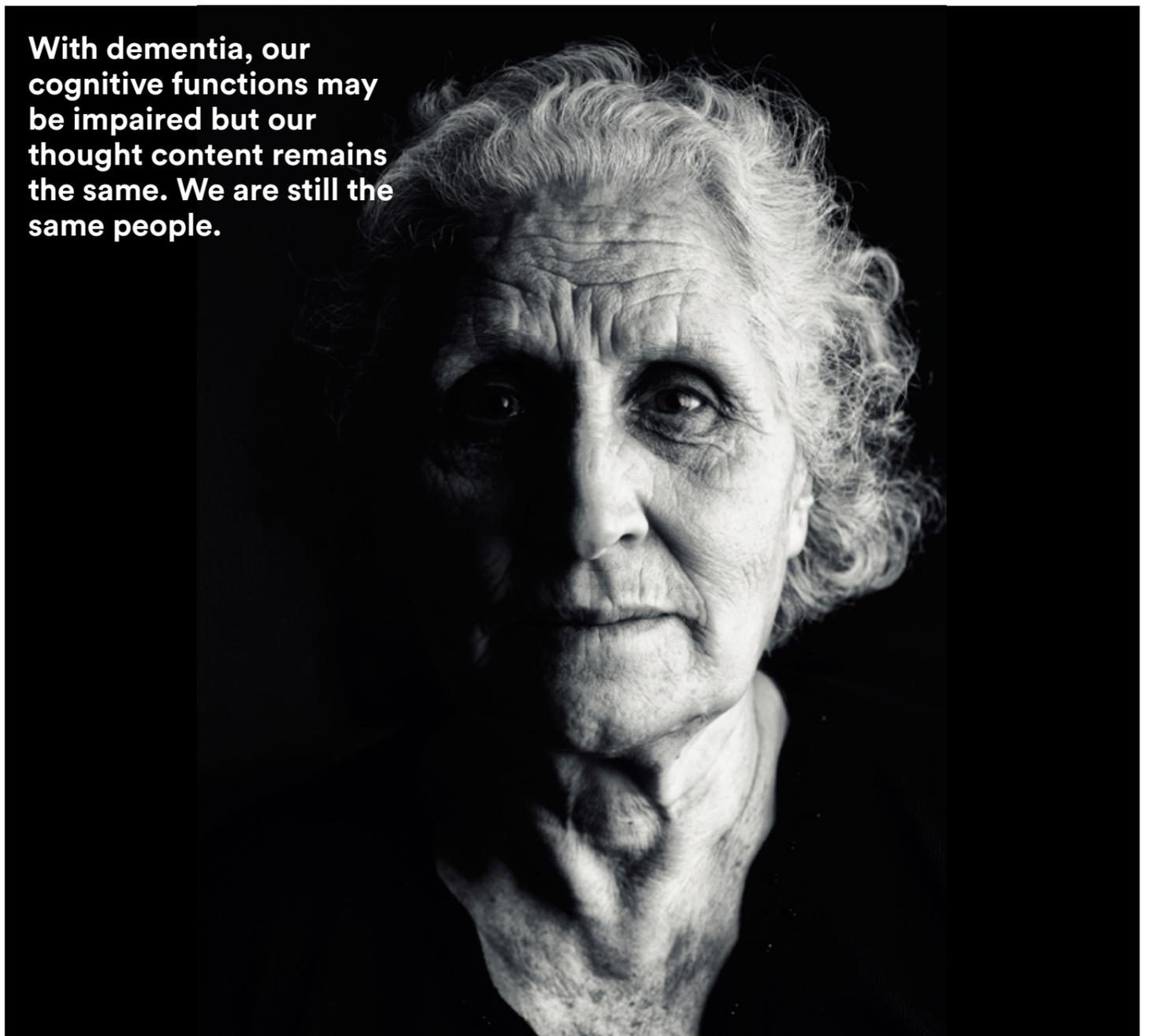
social and intellectual needs and have used pharmacological methods to control disruptive behaviours. Most research into dementia environments has also focused on resolving problem behavior. However, over the past decade, researchers have begun to concentrate on the

intact capabilities of people with dementia.<sup>6, 7</sup>

Although cognitive and explicit memory processes may be impaired, whether residents engage in social activities or not,<sup>8</sup> recent findings indicate that our thought content remains

the same. In other words, our personalities and preferences are effectively intact, albeit distorted through impaired cognitive ability.<sup>9</sup>

**With dementia, our cognitive functions may be impaired but our thought content remains the same. We are still the same people.**



Looking up into the void  
of Peter Zumthor's  
Kolumba Art Museum.

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**New evidence suggests that emotional curiosity can still be aroused in people with dementia, through multi-sensory stimulation. However, little is known about high volumes on resident experience.**

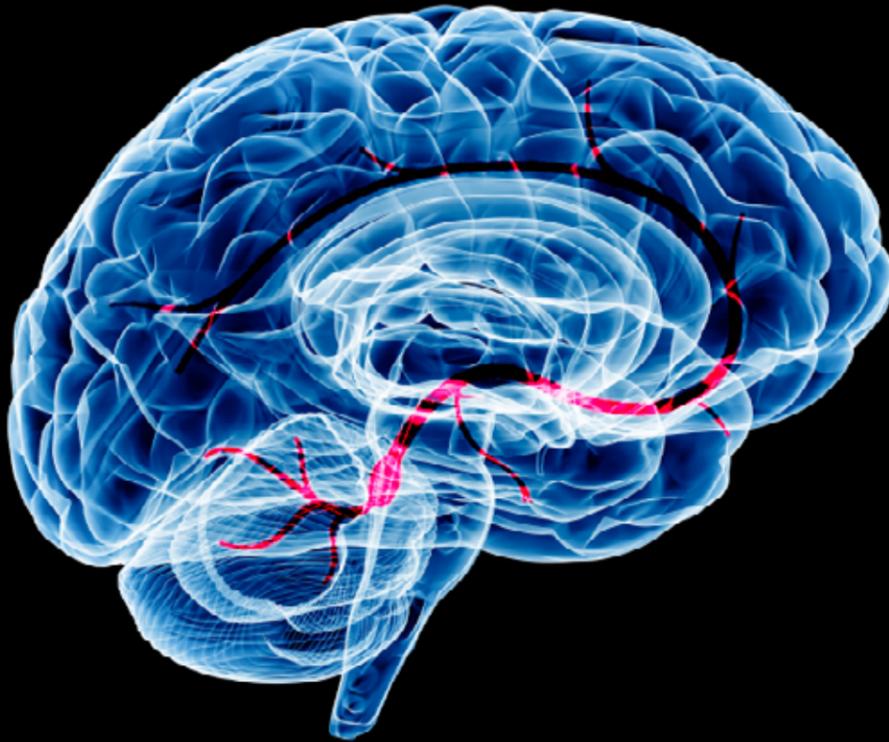
Image: ©

## Design Strategy 3B: Choice

Provide multi-sensory connections between different spaces and activities, including connections between internal living spaces and different exterior environments. Curtains or blinds can also be employed so residents can control view and light levels in semi-private sitting areas.

Provide the opportunity for residents to move towards or away from any given stimulus depending on personal preferences, without becoming completely disconnected from the social group.

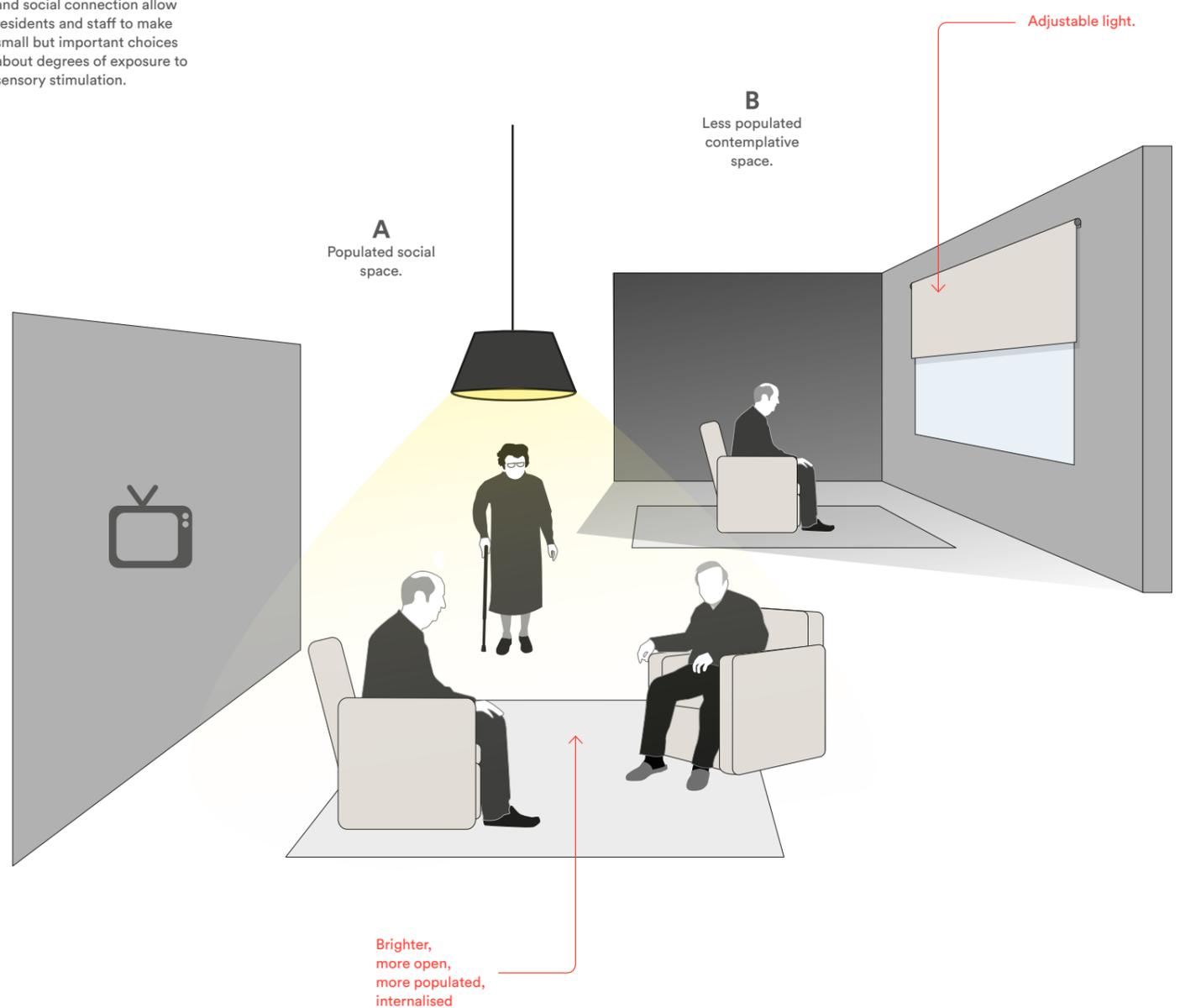
Noradrenaline pathways in the brain



Based on recent neurophysiological research into Alzheimer's disease, researchers now believe that education, mental stimulation and social interaction can have a beneficial impact on the process of the disease itself. These benefits are not only through the brain's capacity to compensate for the disease but are a result of noradrenaline amelioration of amyloid cellular toxicity.<sup>10</sup> The physical environment can potentially play a significant role in supporting this process.

### Choice of environments within one space

Variable degrees of light, sound and social connection allow residents and staff to make small but important choices about degrees of exposure to sensory stimulation.



# B

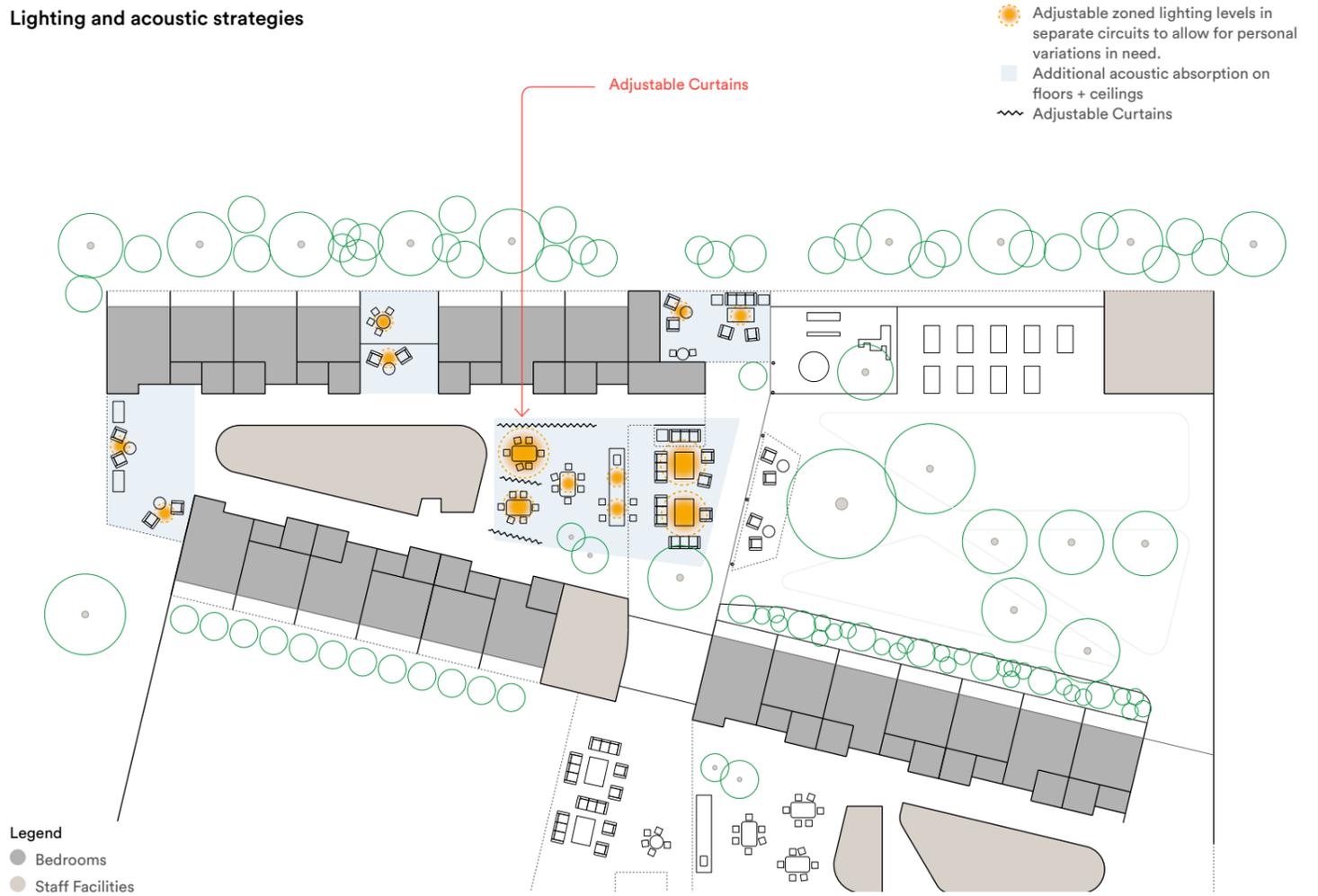


## Design Strategy 3D: Overstimulation

At times where residents are attempting to focus on tasks such as eating or leisure, visual and auditory overstimulation can lead to distraction and agitation. The following measures can help to reduce stimulation levels:

1. In high-noise activity areas reduce reverberation time through the use of absorptive materials on the floors and ceilings.
2. Zoned lighting circuits can allow for variation in lighting levels based on the personal needs or preferences of the resident.
3. Smaller niche-like spaces provide a degree of sensory separation while maintaining some visual connection to the larger activity space.
4. Floor-to-ceiling curtains around seating areas will reduce visual distraction where required.

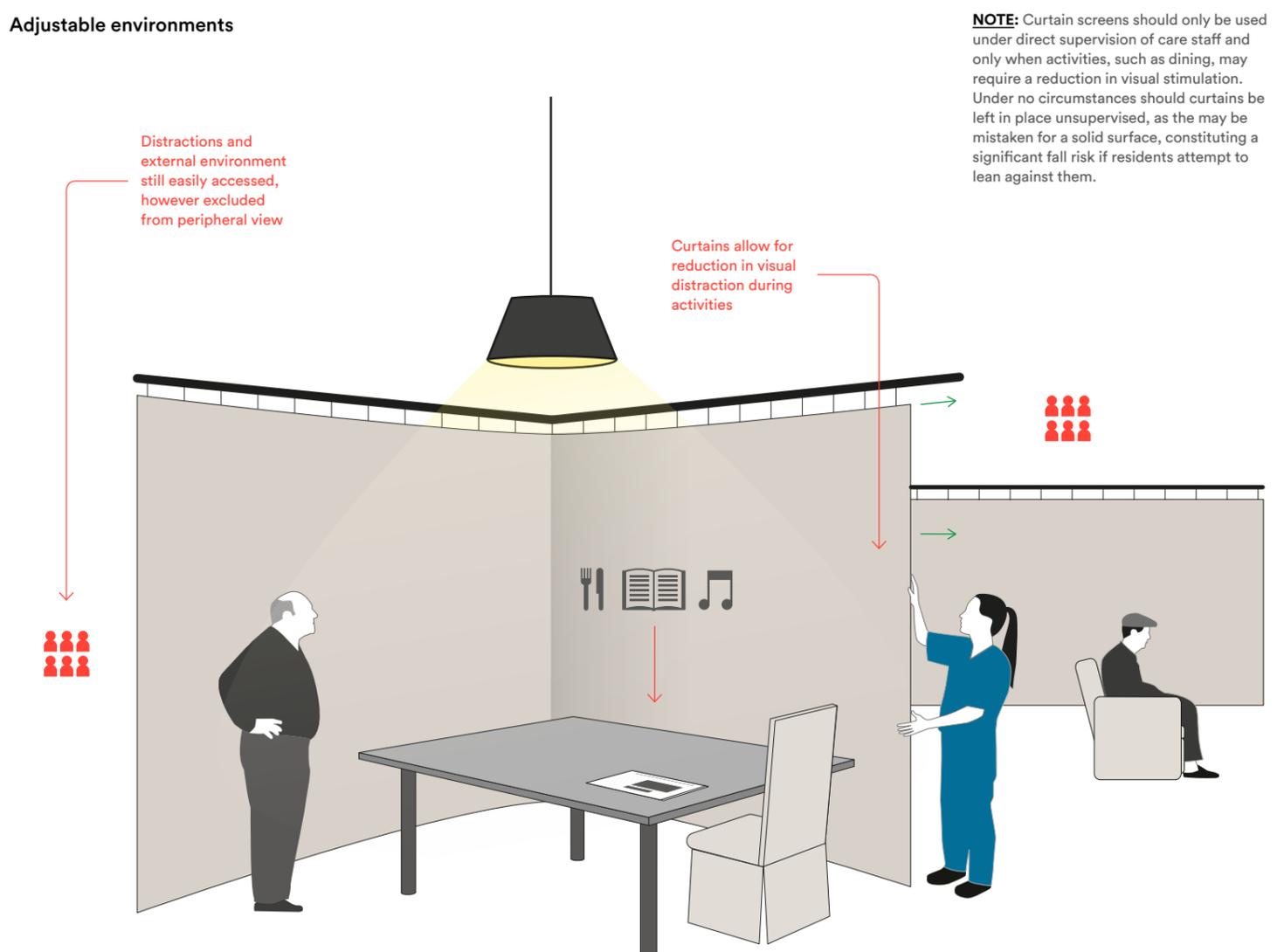
### Lighting and acoustic strategies



In one study, loud noises (loud talking, singing, and clapping, etc.) were associated with overstimulation and disruptive behaviour among residents. <sup>15</sup>

By hanging cloth partitions to eliminate views of surrounding activities, the control of visual stimulation has been found to reduce distractions among residents by up to two-thirds. <sup>16</sup>

### Adjustable environments



# D

## Design Strategy 3E: Social media

Social media sites and interpersonal video communication systems such as Skype facilitate a degree of social connection between residents and the world outside the care facility. Telepresence screens can be wall-mounted in bedrooms and social areas as well as on mobile “robotic” devices.



Technology: Moyle et al (2013) found that telepresence robots such as *Giraff* or *Vgo*<sup>17</sup> can increase social interaction and have an overall positive influence on a resident's quality of life. Moyle argues that they do not replace the staff or family member, but rather provide stimulation and comfort when they are absent.<sup>18</sup>



Giraff robotic telepresence device.



VGo robotic telepresence device.

## Design Principle 4

—  
**Provide a secure and safe environment**

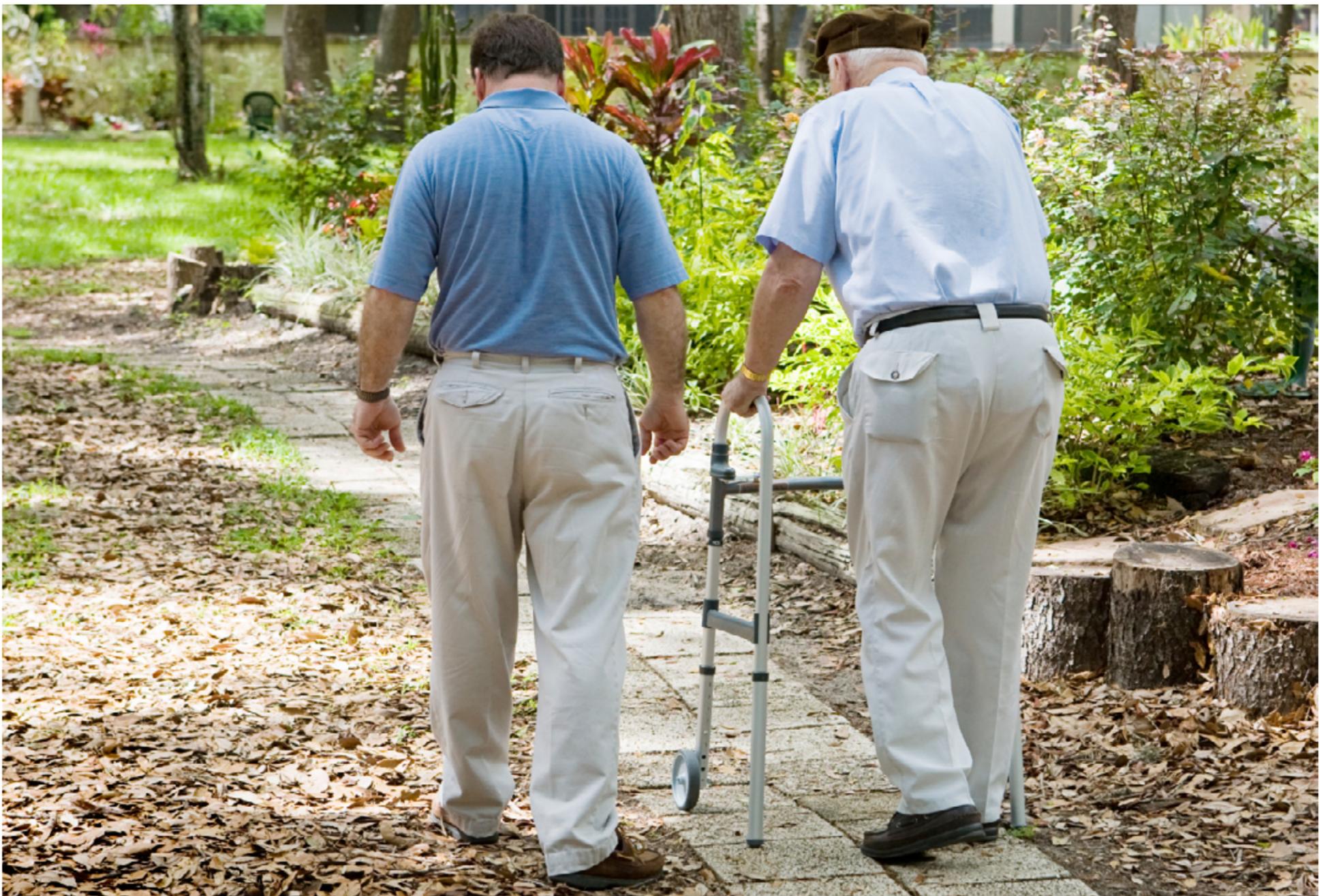
**Stress and anxiety can accelerate the rate of cognitive decline and damage to the hippocampal area of the brain during ageing.<sup>1</sup> It therefore becomes critical to minimise environmental stressors that contribute to negative emotional experiences and unmet needs.**

The need for safety and security varies from person to person, depending on their stage of dementia and their behavioural symptoms. Fear of injury, sustained in a fall for example, is a primary concern for the majority of elderly people, particularly those suffering from dementia, because of its potential to reduce their level of independence. This fear has a significant influence on the speed and manner in which elderly residents move around their environment, and that in turn affects their overall sense of well-being.<sup>2</sup> Although independent movement and the ability to wander have been shown to benefit people with dementia,<sup>3, 4</sup> it needs to be managed safely and the environment has a significant role to play in that process.

→

# 4

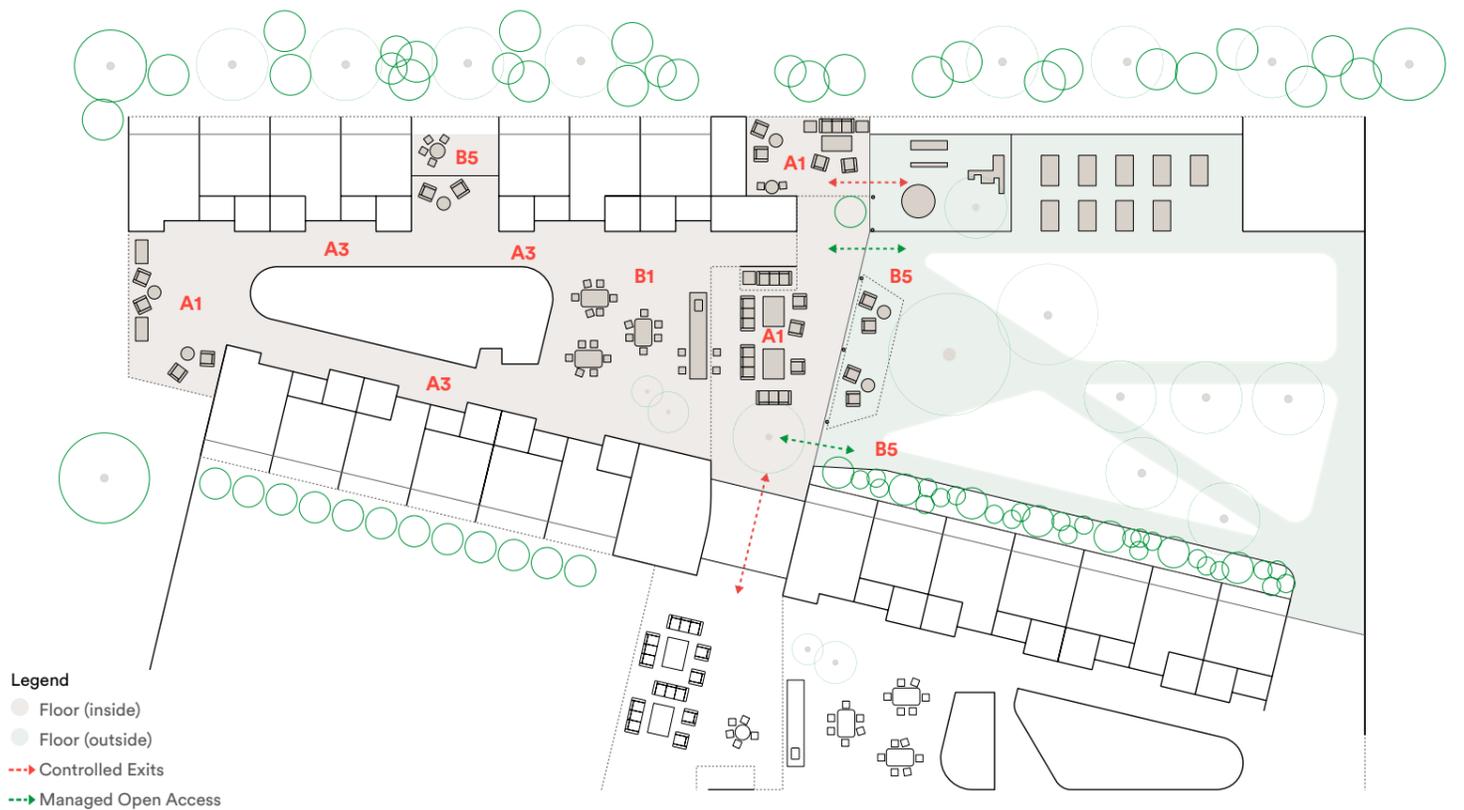
Uneven ground and floor surfaces, such as this one below, contribute significantly to fall-injuries and can lead to a subsequent fear of falling that seriously affects a resident's quality of life.



## Design Strategy 4A: Furniture & fittings <sup>7, 8</sup>

1. Allow sufficient space between items of furniture for residents to move about freely when using walking aids or wheelchairs.
2. Avoid lightweight furniture as it may topple when used for support.
3. Provide secure handrails and grab bars with rounded corners in corridors and stairways.
4. Avoid sharp or projecting edges that can cause injury if fallen upon (for example. A mantelpiece over a fireplace).

### Furniture arrangement strategies for fall minimization



- A1.** Allow sufficient space between items of heavy furniture.
- A3.** Secure handrails and grab bars in corridors. Use 'warm' materials such as timber for handrails.
- B5.** Flush floor finishes and thresholds, particularly outside.

# A

Research shows that falls are most likely to occur at night when residents are trying to get out of bed to use the bathroom. In one study, involving 463 residents over one year, there is clear and convincing evidence that the use of bedrails, which are designed

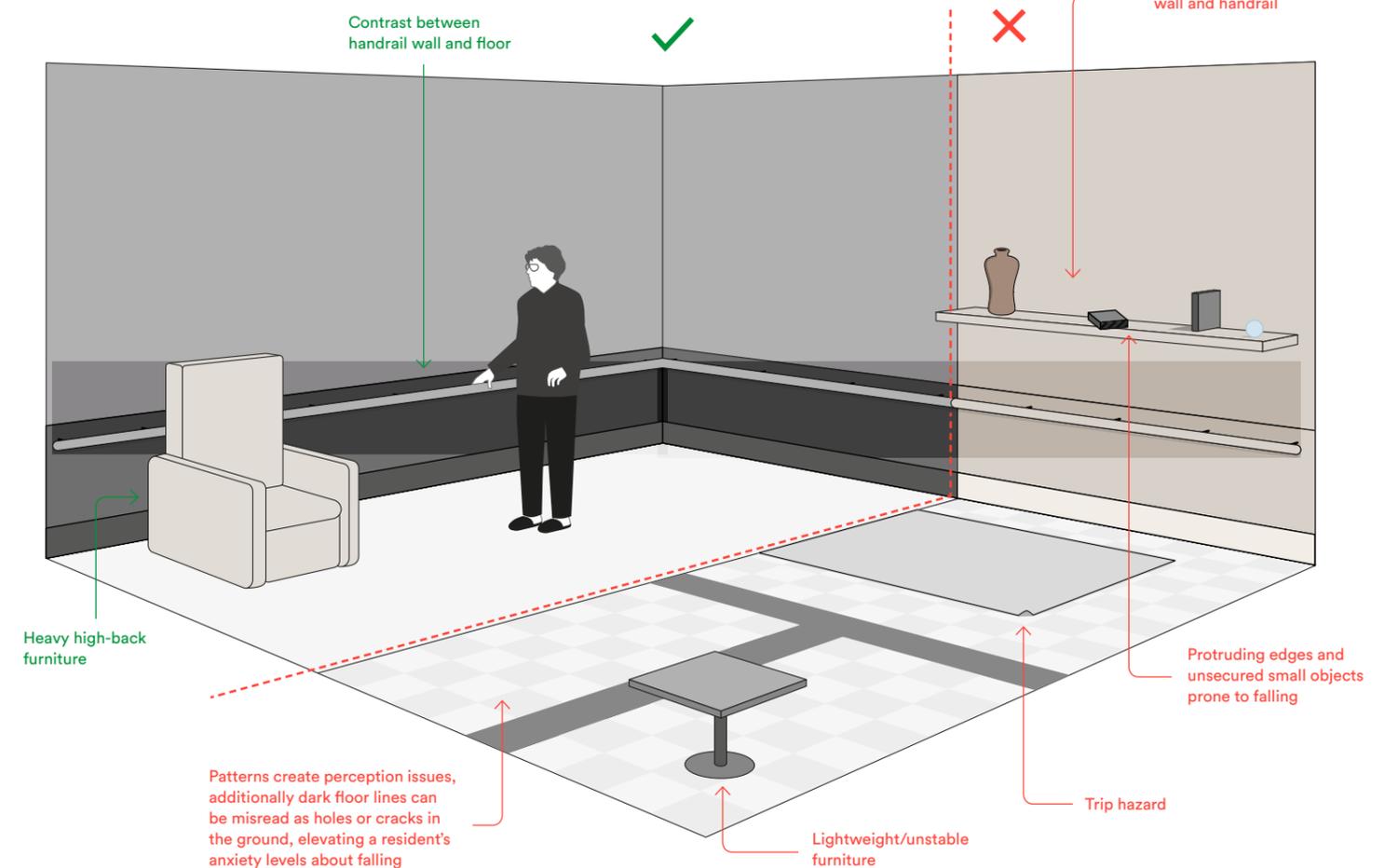
to prevent injury to residents, did not reduce the risk of recurrent falls and subsequent injuries. <sup>5</sup>

A subsequent study found that a reduction in side rail usage was actually associated with fewer bed-related falls. <sup>6</sup>

## Design Strategy 4B: Floors <sup>7, 8</sup>

1. Create contrast between floor and wall colour to improve visibility.
2. Create contrast between furniture and the floor colour to improve visibility.
3. Use heavy, anti-slip floor mats to cushion falls and improve traction.
4. Avoid floor patterns as they have been associated with increased mobility problems such as side stepping, reaching for handrail, or veering while walking.
5. Eliminate trip hazards caused by loose rugs, changes in floor level and uneven finishes particularly in external areas such as patios and gardens.

### Safe and unsafe spatial design for people with dementia



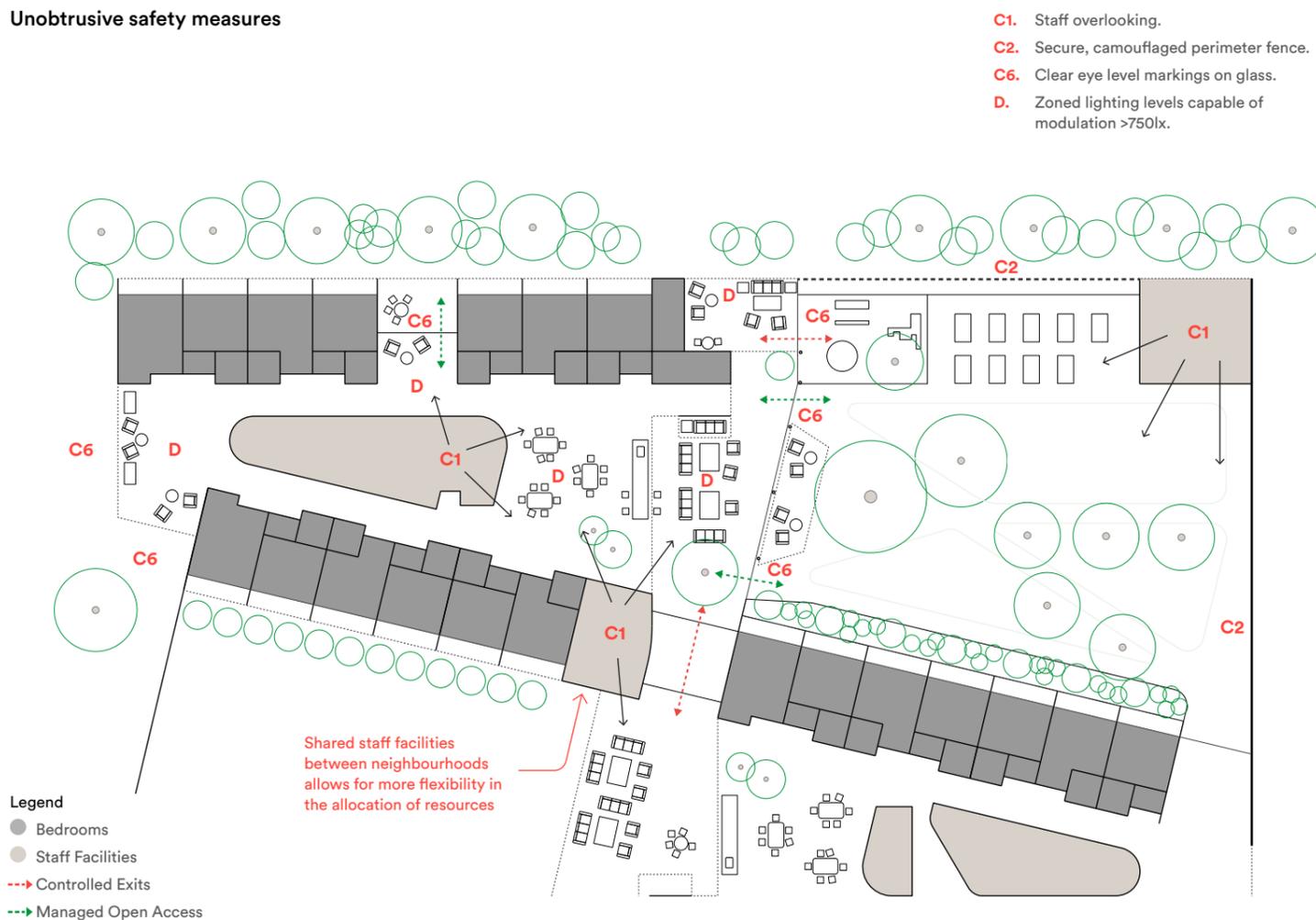
2-dimensional patterns can be misinterpreted as 3-dimensional barriers or holes due to problems with depth perception. Some patterns can also be mistaken for small obstacles and even animals or bugs. <sup>9</sup>

# B

## Design Strategy 4C: Effective Unobtrusive Safety <sup>7</sup>

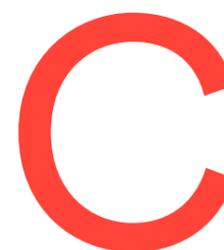
1. Staff overlooking of social/communal areas.
2. A secure perimeter fence or wall around external spaces, camouflaged by plants and trees.
3. Hot water control and safety switches in the kitchen and bathrooms.
4. Removal of small items that can be ingested, or those that can cause injury or damage if thrown.
5. Self-closing, auto-locking storage for cleaning products and other chemicals.
6. If using full height glass doors/windows/partitions include markings at eye level that make the glass highly visible.

### Unobtrusive safety measures



The confusion that accompanies dementia determines the need for a variety of safety features to be built into the environment. As obtrusive attention to safety and security has been found to increase anxiety and agitation, unobtrusive measures are preferred. <sup>10</sup>

By eliminating floor patterns and trip hazards and by including handrails in circulation areas, anxiety about falling can be significantly reduced. Residents are able to spend less time concentrating on the floor and more time looking around as they move through their home.



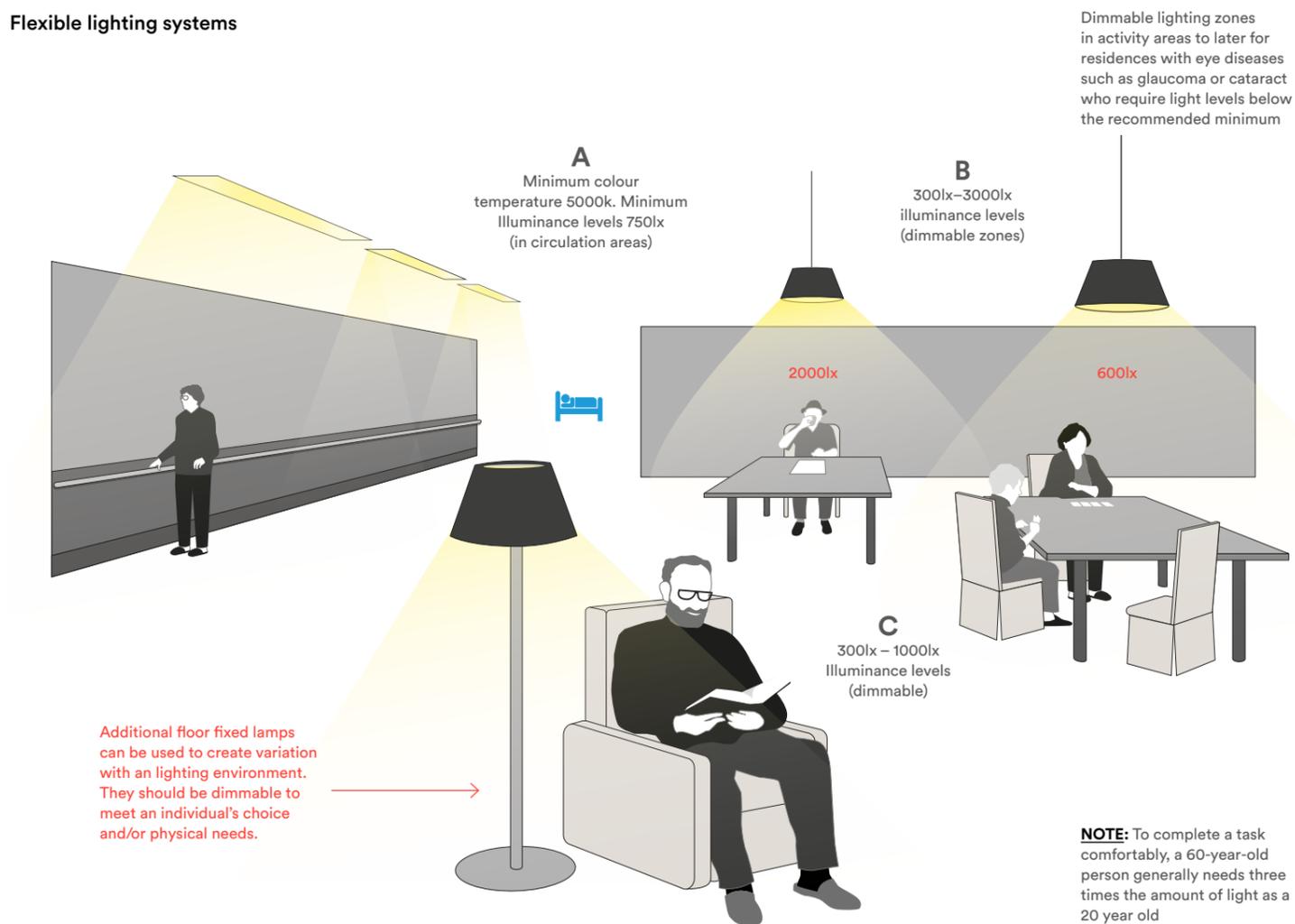
## Design Strategy 4D: Lighting <sup>11</sup>

In activity and circulation areas, the minimum illumination and colour temperature levels are recommended at >750lx and >5000k respectively.

Colour temperature and lx levels can be modulated using different light sources (ceiling, table and/or standard lamps) at different times of the day.

Higher illumination levels (>2500lx) have been shown to have a beneficial effect on insomnia and other sleep issues. However, these levels can be uncomfortable for residents with cataract and glaucoma. Although 600-1000lx will suit most elderly people, it is recommended that lighting levels be capable of modulation between 300 and 3000lx in zoned activity areas.

### Flexible lighting systems



To complete a visual task comfortably, a 60 year old person generally needs three-times the amount of light as a 20 year old.

Most older people suffer from low vision due to both the effect of biological ageing and several pathologies, for instance, a decreased crystalline lens

transmittance. For these reasons lighting levels must be much higher in residential aged care facilities than normal.

Threshold intensities of at least 2500 to 3000lx have been shown to reduce or alleviate insomnia; increase sleep efficiency, total sleep time and restorative slow-

wave sleep; and improve daytime vigilance and sleepiness.

However, studies have also shown that eye diseases such as cataract and glaucoma, can have an impact on preferred illuminance and colour temperature levels, which can be hundreds of lux-units lower than those preferred by health subjects. <sup>11</sup>



## Design Strategy 4E: Exit seeking

Doors in end walls are seen as strong attractors for exit-seeking behaviour. Locating exit doors on side walls of circulation area can reduce this behavior.

Subject to local fire regulations, camouflaged doors have also been found to reduce attention.

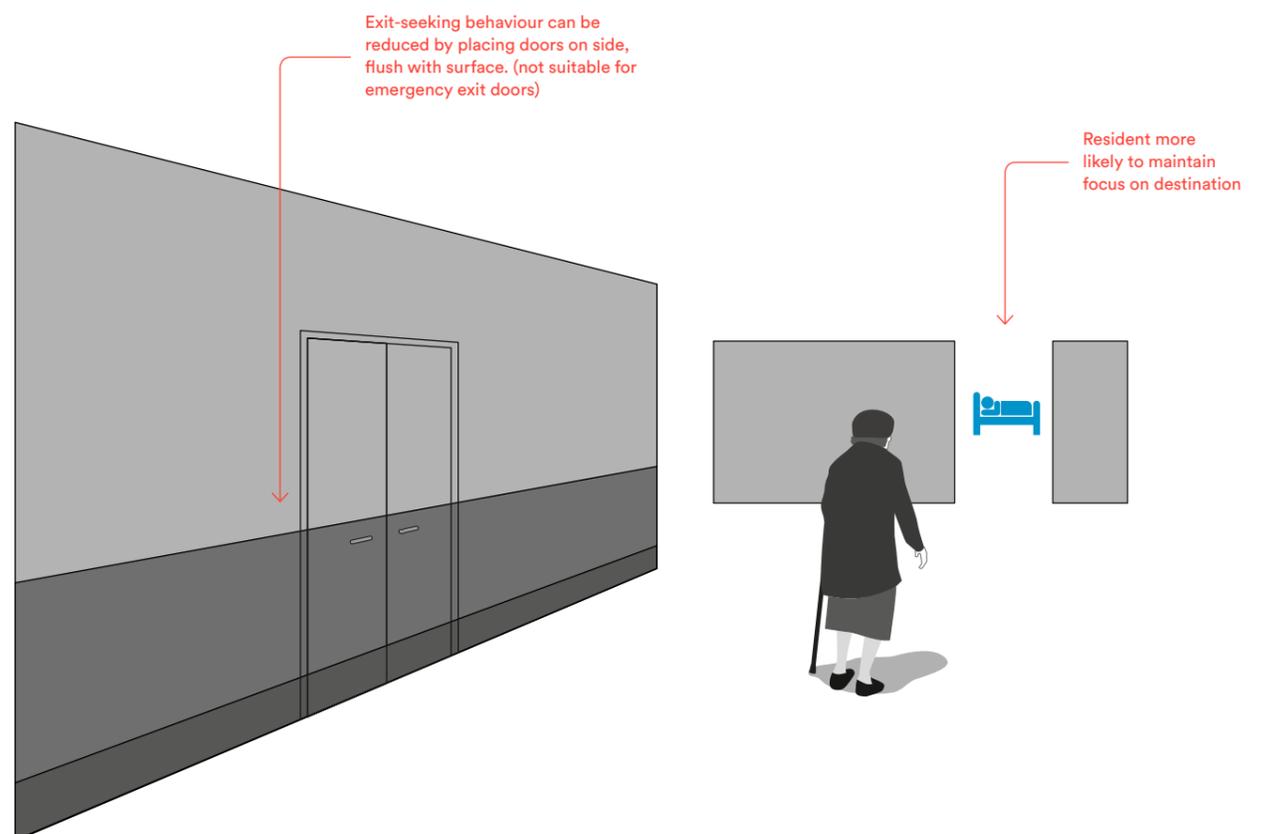
Sensors can also be used to control automatic door-opening systems, therefore assisting with the management of exit-seeking and inappropriate “invasive” behaviour into the private space of others.

Exit control is critical to care management but should be balanced with a resident’s need for autonomy.



Image: © Getty

### Exit-seeking reduction



Exit control is critical to care management. Residents of facilities with well-camouflaged exits and silent alarms have been shown to experience less depression and a reduction in exit-seeking behaviour, however these measures have had mixed results.<sup>12</sup>

In one study door-testing behaviour was significantly reduced when residents found doors were open and not locked—although this is not the case in all circumstances.<sup>13</sup>



## Design Principle 5

—  
Provide a home-like and familiar atmosphere

That which is homelike and familiar will differ for each person, according to personal preferences and living history, however, our need for home to be a place that we make for ourselves, appears to be universal. <sup>1, 2</sup>

Research into the opinions of residents, family and staff continuously refers to the importance of a homelike environment—possibly the most elusive of all qualities to capture in any design. A desirable aesthetic appearance in one part of the world, will differ significantly from another. Because the familiar is so important, aesthetic expression can make a significant contribution if it resonates with local experience. Although it is clear that the physical setting alone is not sufficient to create a homelike environment, it can either support or impede the process. <sup>3</sup>

In one significant study, Tanner et al conceptualized the home environment as having three primary modes of experience: the physical home, the social home and the personal home—suggesting that organizational, personal and social needs must be equally considered in any design process. <sup>2</sup>

→

Below:  
Alcacer do Sal, Portugal  
—  
Architects:

# 5

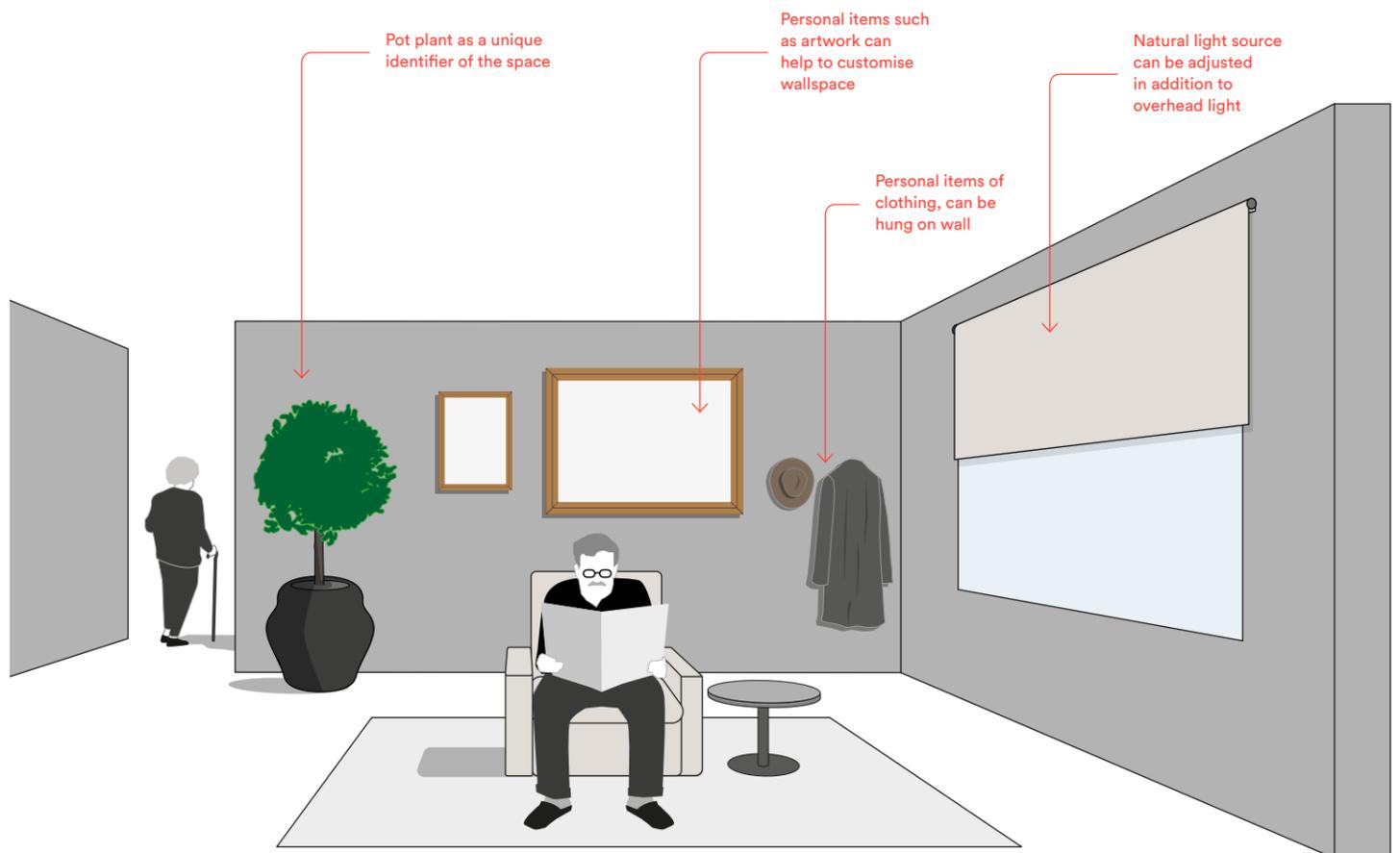


Image: ©

## Design Strategy 5A: Personal home

Provide opportunities for limited personalisation of social spaces, not just in the individual bedrooms. Smaller, more intimate “niche” areas off main circulation paths, can have distinct environmental qualities of light, sound, scale, view etc. These niches can be “chosen” and modified to some extent by those who seek to remove themselves from the main social areas, without retreating to the complete privacy of their bedrooms. <sup>7, 8, 9</sup>

### Personalised semi-public space



 Space is semi-public allowing other residents to visit and customise the space.

**The appearance of home is culturally and personally determined. To be “homelike” there must be opportunities to act upon a place.**

The creation of a quality care environment requires us to reconcile the ambiguities of the nursing home as a home. We now understand that the ability to act on our physical environment is the primary way in which people “make” a place into a home for themselves. <sup>2</sup> By allowing personal habits to guide institutional routines and by supporting meaningful activities, residents begin to create a private home—one that is distinct from the professional home of the care provider. <sup>4</sup>

The ability to construct a place for personal rituals becomes critical to a resident’s sense of self and their sense of belonging in the context of their domestic environment. The performance of personal, daily tasks or rituals contributes to the creation of “insiderness,” a sense of familiarity that is “rooted in bodily routines” that are taken for granted. Home becomes a place of relaxation because of the stability of routine behaviour and experience. <sup>5</sup>

The personal home: A place of self-expression, identity, and personal control that is a central reference point in a person’s life, encapsulating feelings of familiarity, security, and belonging. <sup>2</sup> The personal home is one in which family can be involved in everyday activities with residents and staff, using activity kitchens, small indoor and outdoor eating areas, recreation areas and quiet private areas for residents and family. <sup>10</sup>

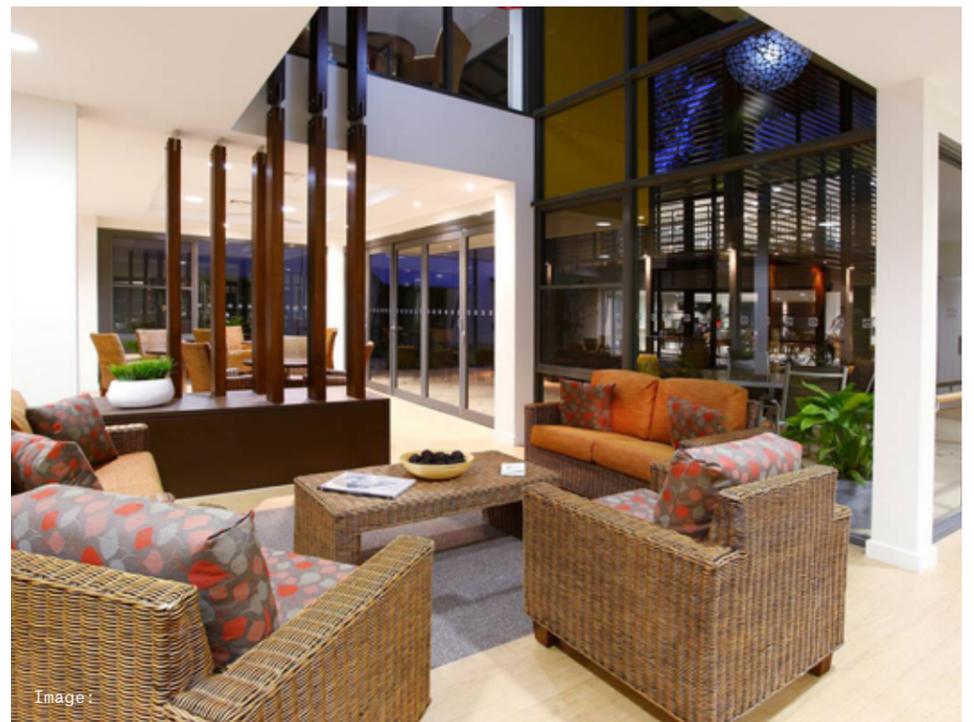


Image:



Image:

Above:  
Regis Parkland,  
Queensland  
—  
Architects:

Left:  
Severna Park, Maryland  
—  
Architects:

# A

## Design Strategy 5B: Physical home

Materially, the physical home can support reminiscence through the use of recognisable, local materials and textures that resonate with the past experiences of residents. <sup>11</sup>

### Research conducted on smaller residential “clusters” has found greater quality-of-life indicators, greater emotional health, and greater satisfaction with the nursing home as a place to live.

Residential facilities dedicated to dementia care now tend towards smaller units of 12–15 beds. Various terms have been used to describe these different configurations, including pods, clusters, households and neighbourhoods. The concept seeks to reverse the loss of control that elders experience by emphasising competence and participation in daily activities in the household.

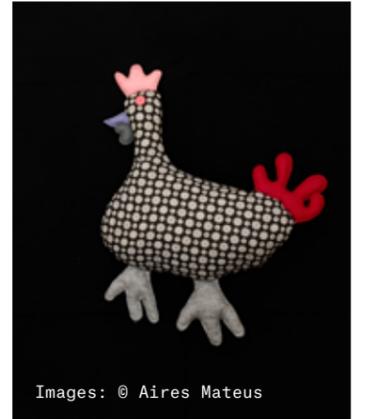
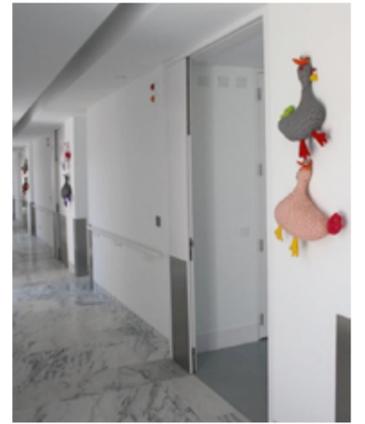
Interestingly, residents of the smaller units are less likely to participate in structured activities than residents of the traditional homes. However, they also exhibited significantly lower levels of depression and late-life loss of activities of daily living. <sup>6</sup>

Local stone has been widely used in the design of the Montemurlo Aged Care Facility in Prato, Italy.



Image: © Pietro Savorelli

Situated in rural Portugal, each door at Alcacer do Sal is differentiated from another by the use of specially designed chickens that resonate with the past experiences of people from a mainly farming community.



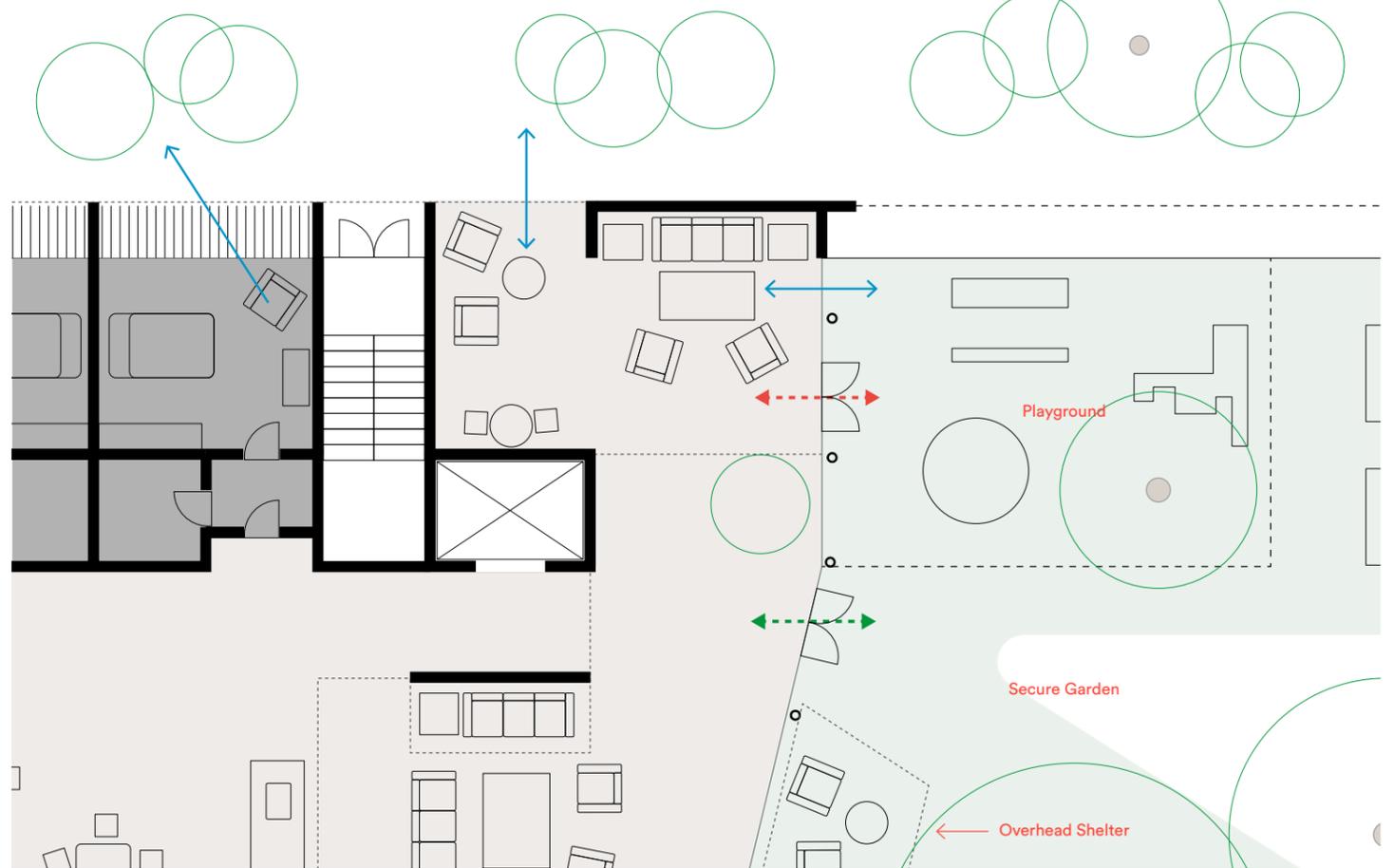
Images: © Aires Mateus

# B

## Design Strategy 5C: Social home

Allow for semi-private smaller sitting areas, where residents can meet with guests, family members and their children. Such spaces can be along circulation paths or adjacent to larger social spaces and connected to a dedicated outdoor sitting/play area.

Choice of settings to support diverse social activity



- Legend
- Bedrooms
  - Floor (inside)
  - Floor (outside)
  - Controlled Exits
  - Managed Open Access

Encompassing relationships with significant others, such as a spouse or family member, who may often inhabit the same physical environment and also includes those who may enter the home on occasion or exert an influence from outside the home such as relatives, neighbours, friends, and community networks. <sup>2</sup>

# C

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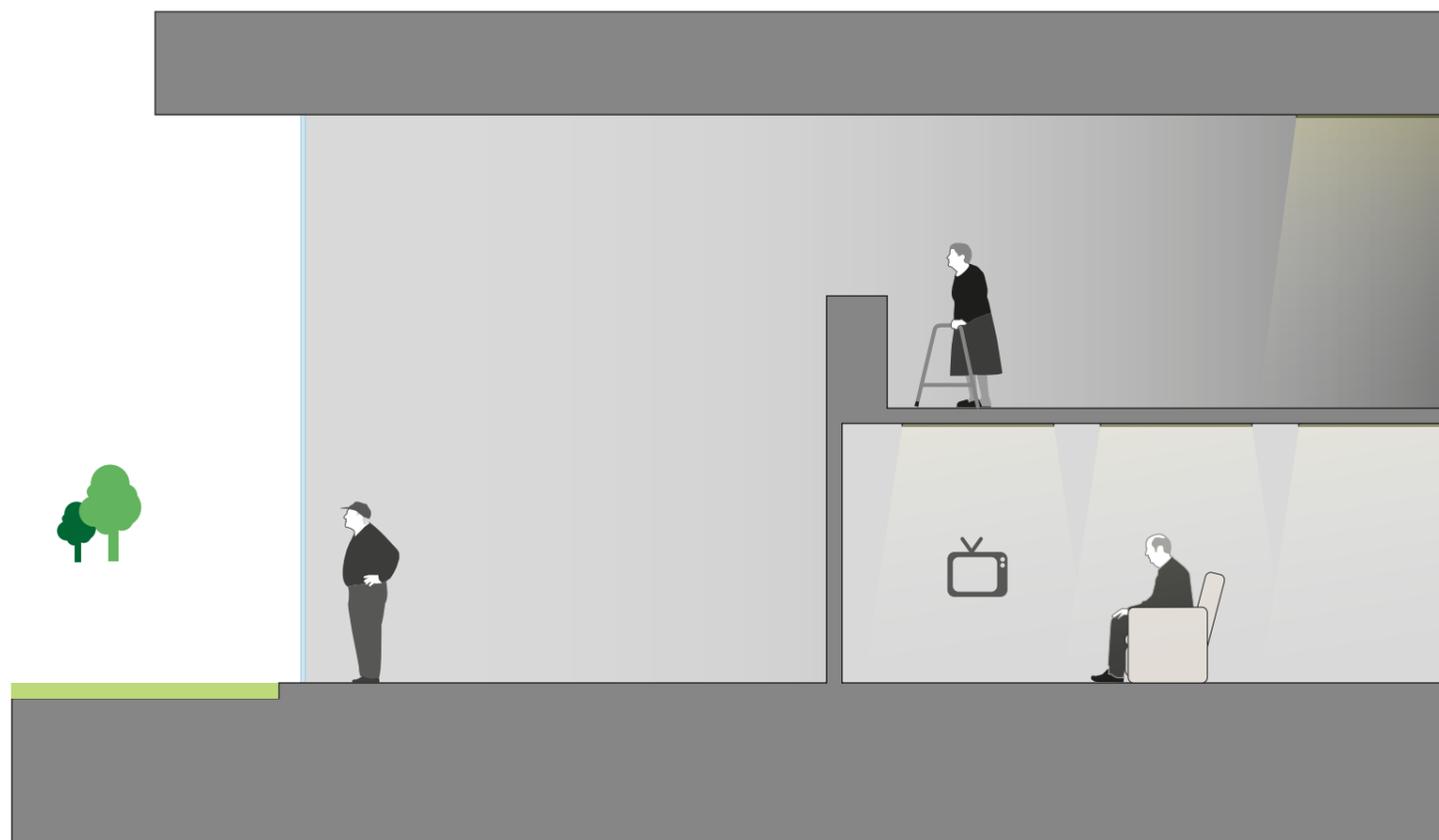
That which is homelike and familiar will differ for each person, according to personal preferences and living history, however, our need for home to be a place that we make for ourselves, appears to be universal. <sup>1</sup>



## Design Strategy 5D: Scale

The trend over the past two decades has been to reduce the size of the aged care unit, from 60 “beds” to households accommodating anywhere from 9 to 24 residents, particularly when it comes to the care of mobile, people with dementia. There is, however, no reliable research that explores the impact of large, high volumes on resident experience—other than the potentially negative impact of excessive noise. Given the possibilities for such volumes to stimulate sensory experience, further research is recommended.

Evidence is needed on the impact of spatial volume on people with dementia



# D

The size of a residential-care unit is now recognised as a significant contributing factor to a resident’s sense of belonging.<sup>12</sup>

Larger units are associated with poorer resident outcomes including higher agitation and aggressiveness, faster

intellectual deterioration, higher rates of depression, and greater psychotropic and antibiotic medication use. Smaller units appear to have a number of positive benefits such as higher motor functioning; greater friendship formation; less anxiety, sadness, and depression; more

positive activity involvement; and greater mobility.<sup>13</sup>

Studies have also found that staff in larger units feels more pressure, regardless of residents’ need for physical or psychosocial assistance. Smaller units, conversely, are less stressful

for staff, allowing them to have better interactions with residents, which can improve their quality of life and have a positive overall impact on staff retention rates.<sup>13</sup>

## Design Strategy 5E: Dining

The evidence supports the use of smaller dining spaces, however, if large dining facilities are required, consider using visual and acoustic barriers to create smaller niche-like areas within the larger dining area.

Where possible provide direct visual connections between kitchen and dining areas—providing staff with views of both areas, while creating connections between the act of preparing and the act of eating food.



Smaller, “non-institutional” dining rooms have been associated with increased food intake. “Family style” dining at small tables has been linked to increased social interaction and communication, and to improved eating behaviour.<sup>13, 14</sup>

Larger scale, institutional care practices can however provoke disruption and agitation, even in smaller homelike settings.<sup>15</sup>

In one study, assaults were reduced by over 40% when residents were no longer crowded into elevators to reach the centralised dining rooms.<sup>16</sup>

Where kitchens open directly onto dining rooms, research has shown that both facilities tend to be used more actively because the functional relationship is apparent to residents, activity is concentrated and care staff have greater degrees of oversight.<sup>17</sup>

# E

**Design  
Principle 6:**

**Balance between  
the private and  
the social**

**6**

Although privacy and dignity are considered very important for residents of aged care facilities, and their families, lack of social connection is also experienced as a significant loss. <sup>1</sup>

Care providers face the great difficulty in achieving a balance between a resident's desire for solitude and the potential benefits of strong social ties, <sup>2</sup> because they understand that, above all else, individual choice should be respected and accommodated, wherever possible.

These potentially competing, and variable, needs for privacy and social connection are linked to the concept of human territoriality: "a psychological and interpersonal process that enables individuals and groups to assert ownership over space, display identity, and regulate social interaction and systems." <sup>3</sup>

In 1975, the social psychologist Irwin Altman defined territoriality as a "self-other boundary regulation mechanism". He distinguishes between primary (private spaces where there is a strong sense of territorial ownership), secondary (a middle ground that is both public and familiar such as a neighbourhood bar) and public places that have a limited importance to users and are occupied for limited time. The social spaces of residential facilities work well when used as secondary (between) spaces but problems can arise when users treat them as primary (private) spaces. <sup>4</sup> Conflicts can occur when "others" actively dispute territorial claims. <sup>5</sup>

A key design strategy is to create different environmental qualities within distinct areas of the same space, affording residents the opportunity to own a part of a larger space, without having to make many physical changes.



## Design Strategy 6A: A Community connection

Consider ways in which residents can maintain a connection with the broader community, from within the care setting. For example, care facilities can be integrated into their urban or suburban context alongside other community facilities such as kindergartens, schools, day centres and medical clinics. At the very least, part of the social area may have a view of external streetscapes.

Based on research undertaken in the US, the keys elements that can build capacity for intergenerational integration in a residential care facility are:

1. It is located in, and open to, the local community.
2. It becomes a hub of activity for people of all ages.
3. It is actively promoted as a place to visit.

As with other design strategies it is important to ensure that residents can choose the level of integration that suits their personal preferences.

Co-locating local sports and aged care facilities can be a way for residents to maintain connections with the community.



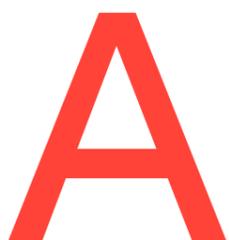
Staff and family can mistakenly conceptualise dementia as a loss of self, resulting in missed opportunities for continued social connection. However, the needs and desires of residents are often no different to individuals who do not have dementia. They desire to go outdoors, into the community and engage in stimulating conversations. <sup>6</sup>

38 residents and 15 staff participated in the Generation Station project, implemented in a Pennsylvania nursing home in the US, in 2001. The home included a computer lab, woodworking studio, library, pharmacy, outpatient clinic, beauty shop, hairdresser, bank and exercise room, all designed to be used by residents but also by members of the wider community.

Residents and local youth groups were brought together through “Open Day” events. The study found that both residents and young people benefited from the transaction, so much so that the programs were still in place and were evolving, two years after the study was completed.

The researchers concluded that intergenerational integration is about building an institutional capacity to conduct a suite of intergenerational programs rather than focusing on a singular, finite activity-specific program. Capacity is built through social and institutional policies, cultural and community practices, and environmental design strategies that aim to promote intergenerational engagement. <sup>7</sup>

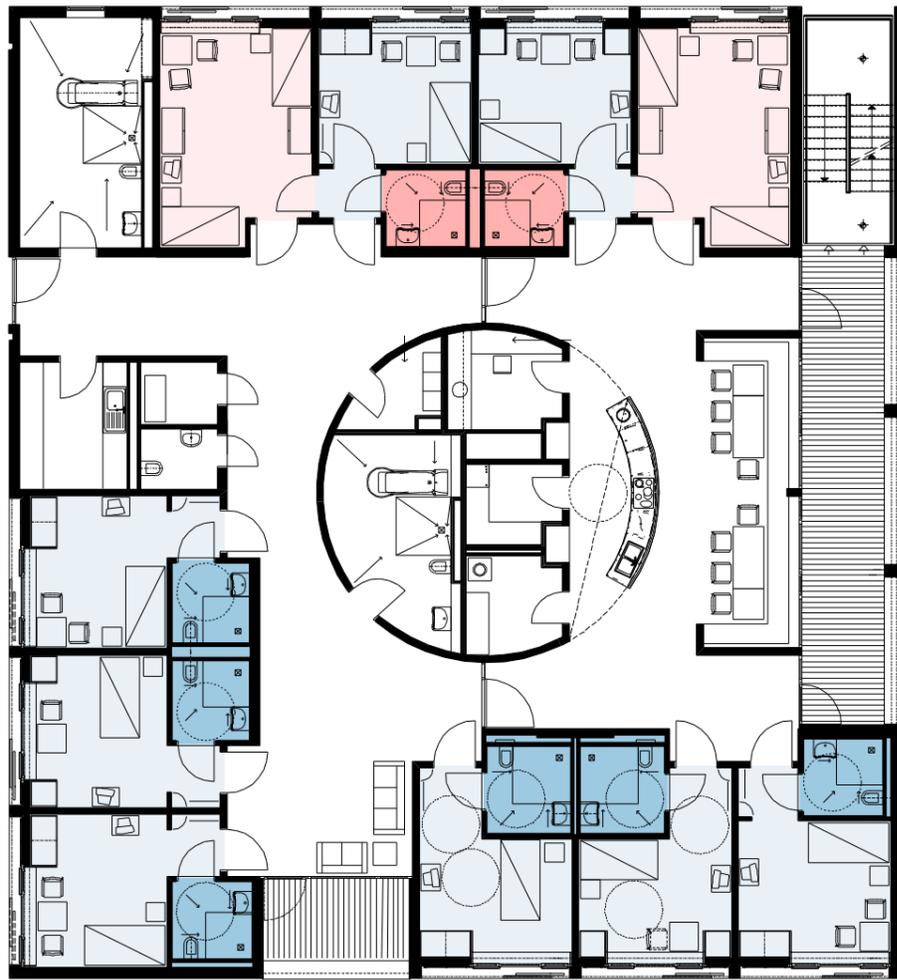
Supervised residents can contribute in many ways to community-based amenities including parks and schools.



## Design Strategy 6B: Bedrooms

Provide options for shared and private rooms based on local preferences. The example of the Nuremberg Dementia Competence Centre shows a typical “neighbourhood” cluster with 12 residents occupying 10 bedrooms in each cluster. 8 beds are in private rooms and there are two shared rooms per cluster. This scenario accommodates couples or those who desire to share a room along with those who require privacy.

Dementia care neighbourhood showing mix of double and single bedrooms.



**Legend**  
 ● Single Bedroom  
 ● Private Ensuite  
 ● Shared Bedroom  
 ● Shared Ensuite

Image: © Feddersenarchitekten

Several studies have found that many residents value the peace and autonomy of a single room while others found reassurance from having a roommate. In one study, residents with Alzheimers Disease—in facilities with more individual rooms and therefore more opportunity for personalisation—experienced lower levels of anxiety and aggression than control groups.<sup>9</sup>

Shared rooms are quite common in the UK, Asia and Europe, but less so in Australia and the US. Further, research is required on a project-by-project basis to identify local preferences, but available research provides little direction on this topic.<sup>1, 10</sup>



Image: ©

**Defence responses may sometimes occur when territorial boundaries are “violated”. If a senior centre succeeds in providing a home-like atmosphere, regular users may lay claim to certain settings, which bolster group identities but also have the negative effect of excluding newcomers. However, the evidence does not encourage a reduction in levels of autonomy.<sup>5</sup>**

Even though territorial disputes can create problems for carers, the disempowerment that results from abridging territorial claims can be even more problematic. For example, one study noted that residents were angered when their free-choice system of seating changed to one where they were escorted to tables.<sup>8</sup>

Above Right:  
A double bedroom and balcony at Alcacer do Sal, Portugal.

Architects:

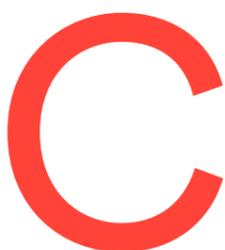
# B

## Design Strategy 6C: Diversity

Secondary social spaces provide residents with the ability to sit apart from, but remain visually connected to the main group. These “peripheral” spaces provide a threshold that allows individuals to participate or withdraw depending on their personal feelings about social interaction at a given moment in time.



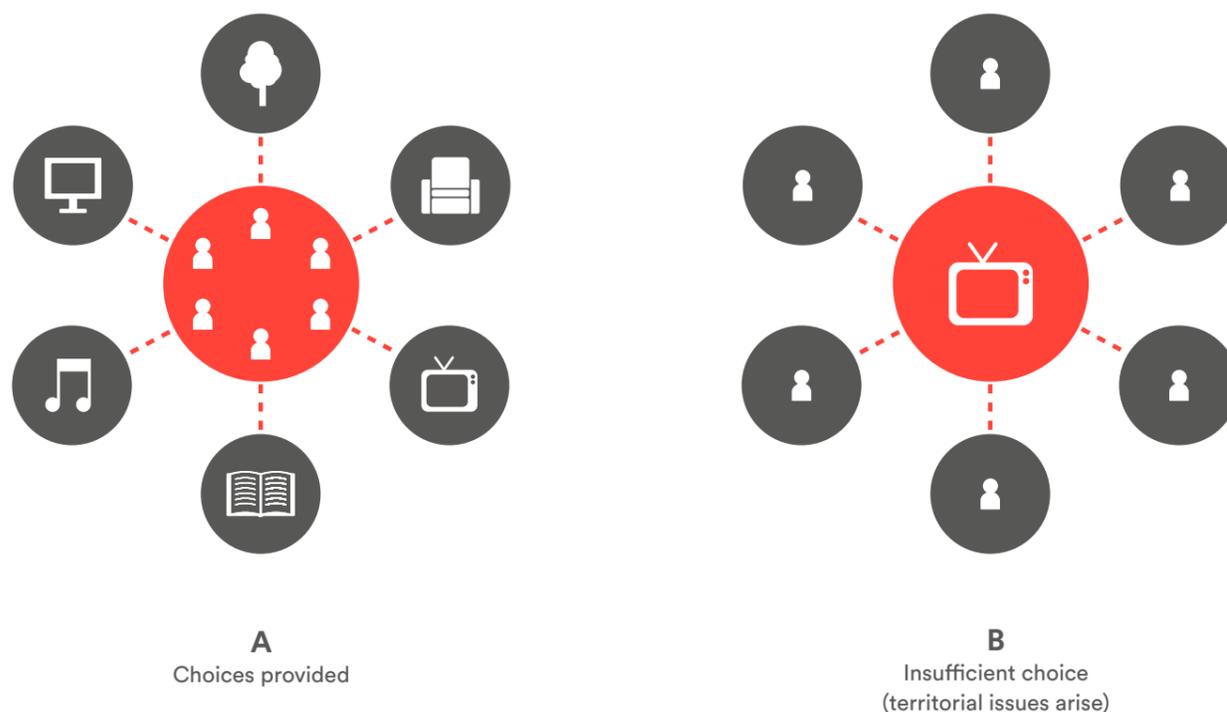
The degree of social withdrawal among residents has been shown to decrease where common spaces have high levels of variability, allowing residents to become familiar with their location and purpose.<sup>9</sup>



## Design Strategy D: Conflict management

Supporting a resident’s ability to exercise personal choice and self-control can diminish conflicts arising from the need to stake a territorial claim. In addition, a variety of activity spaces (craft rooms, computer labs, libraries, gardens and exercise studio etc.) can provide residents with the capacity to make choices and find a place that fits their changing needs and desires.

Choices



Human territorial behaviour can lead to conflict in closed environments. Research, involving over 300 participants in the US, discovered that centres with a wide variety of shared settings and a strong policy of self-governance exhibited fewer territorial conflicts than those

with a limited choice of social spaces. They suggest that a lack of autonomy among participants in the latter centres may have enforced a sense of “lower social status”, leaving the dining tables and seats as the only territorial resource left for participants to claim.<sup>5</sup>



# Home and the Familiar: Lessons from Montemurlo.

Case Study One  
—  
Dr Darragh O'Brien

# C1



Image: Pietro Savorelli

In the dry hills of Montemurlo, above the medieval town of Prato, Italy, Ipostudio's Residential Aged Care Facility grows comfortably from an historic, agricultural landscape, characterised by the traditional dry stone terraces of the region.

## Montemurlo Aged Care Facility Overview

### Credits

Architects:  
ipostudio architetti

Client:  
Azienda Sanitaria Locale  
4 Prato

Program:  
Health Centre and  
houses for elderly people

Photography:  
Pietro Savorelli,  
Jacopo Carli,  
Ipostudio Archiève

### Consultants

Structural Engineer:  
Niccolò De Robertis  
-aei progetti srl

Environmental systems:  
Paolo Pietro Bresci e  
Leopoldo D'Inzeo  
- Consilium srl

Contractor:  
Restructura soc coop arl  
- S. Arsenio (SA) Staccone  
spa Costruzioni Generali  
- Roma

Construction supervisor:  
Nicola Freddi - STS spa -  
First Construction Stage  
assisted by Elisabetta  
Zanasi Gabrielli  
- ipostudio architetti.

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**This difference between an open and closed environment is perhaps nowhere more critical than in residential aged care.**



Image: Jacopo Carli

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#### From The Architects

For the design of residential care facilities, the monastic analogy becomes extremely interesting and useful. The convent... is constituted as a city block, identified as an articulated and complex structure of spaces where the placement of private space is inversely proportional to the degree of accessibility. In the monastic structure it is also possible to identify three spatial systems that are useful when considering the organisation of a *Residenza Sanitaria Assistenziale (RSA)*: public space represented by the Church and the cloister of catechumens; collective but private space constituted by the refectory, the aula magna and General Services structures; the private space of the cells.

However, there is another fascinating aspect of monastic typologies that might be interesting for the purposes of analogy: the wealth and the articulation of the outdoor spaces that are distinguished depending on their location in the structure and their relationship with the interior spaces. All this can be a valid interpretation of a clearly expressed general concept which says that taken together, the solutions must configure a living organism of residence-scale where, in addition to domestic spaces, there are areas dedicated to social relations.

Extract From:  
Arbizzani, E and Di Giulio, R. (eds.), *Health Assistance Residences-design and realization*, Maggioli editore, Rimini



Villa Medici di Belcanto

A protected group of ancient trees, existing rural buildings and a unique landscape became the conceptual generators for this project. For the architects, the site is intrinsically connected to the history of place, “a survivor of new farming techniques that, elsewhere, have reshaped the soil profile”.

The architecture is reminiscent of the farmyards and walled villages we associate with the Tuscan landscape. Appearing to support an elevated yard populated by independent structures, a single, punctuated stone wall presents itself to the valley and the city beyond, its curved profile resonating with the contours of the land.

The idea of context is crucial here, not only to the quality of the architecture but also to the purpose for which it exists. Montemurlo is offered as case study for two significant issues that are critical to the design of any residential aged care facility, anywhere in the world: The first being the concept of Care Facility as Home and second, the manner in which residents are connected with each other and the world beyond. This difference between an open and closed environment is perhaps nowhere more critical than in residential aged care.

Montemurlo is home to 40 elderly residents who share the facility with approximately 10 day care visitors. Equal numbers of high and low care residents are accommodated separately across two levels—below the entry “yard” with its free-standing pavilions—in the volume formed between the wall and the slope of the hill. The whole complex is arranged in a radial grid overlooking the valley.

Ipostudio drew their inspiration from a combination of archetypes: the Convent and the Farmyard, both being relevant, not only in the context of the Tuscan hills, but also because they contain highly specific communities that are, by necessity Heterotopian<sup>1</sup>—places that are simultaneously open and closed—and therefore highly relevant to the unique circumstances of a residential aged care facility. The merging of these references became critical, not only to the architectural aesthetic, but also to the organisation of functional areas. The farmyard (“aia”), characteristic of Tuscan farmhouses, *inspired* the idea for a sort of rural “piazza” that provides access to the facilities that are open to external guests: the day care centre, places of collective life (offices, kitchens and the place for worship) and the main entrance.



Rural House in Tuscany

The physical setting alone is not sufficient to create a homelike environment—it can only facilitate that possibility. Organisational and social aspects of the environment are also necessary components in the development of a small, homelike therapeutic setting.<sup>2</sup> This implies helping residents to create a private home distinct from the professional home, allowing residents’ personal habits to guide institutional routines and supporting meaningful activities.<sup>3</sup>



Image: Jacopi Carli



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**The social home extends to the world outside of its physical boundaries because that is also the world of our past.**



Image: ipostudio

## The Act of Homemaking

There is some agreement among researchers that homes must be made by the people that inhabit them. For a care facility to be even considered homelike, residents must have the ability to act on their physical environment. The home environment is conceived as having three primary modes of experience: the physical home, the personal home and the social home and the residential care home at Montemurlo is considered in this context.<sup>4</sup>

The physical home: is defined by familiarity of materials, design, layout; “the space that can be measured and is shaped by function, culture and history”.<sup>4</sup>

The personal home: being a place of self-expression, identity, and personal control becomes a central reference point in a person’s life that encapsulates feelings of familiarity, security, and belonging.

The social home: encompasses relationships with significant others, such as a spouse or family member, who may often inhabit the same physical environment and includes those who may enter the home on occasion or exert an influence from outside the home such as relatives, neighbours, friends, and community networks.

The social home extends to the world outside of its physical boundaries because that is also the world of our past. Place design and strategy can play a significant part in the creation of a physical, personal and social home.

---

**The Physical Home is defined by familiarity of materials, design, layout; “the space that can be measured and is shaped by function, culture and history”.**



Image: Pietro Savorelli

## Plan Key

1. General Services
2. Morgue
3. Heating Plant
4. Sanitary Services and Offices
5. Entrance
6. Place of Worship



Image: ipostudio

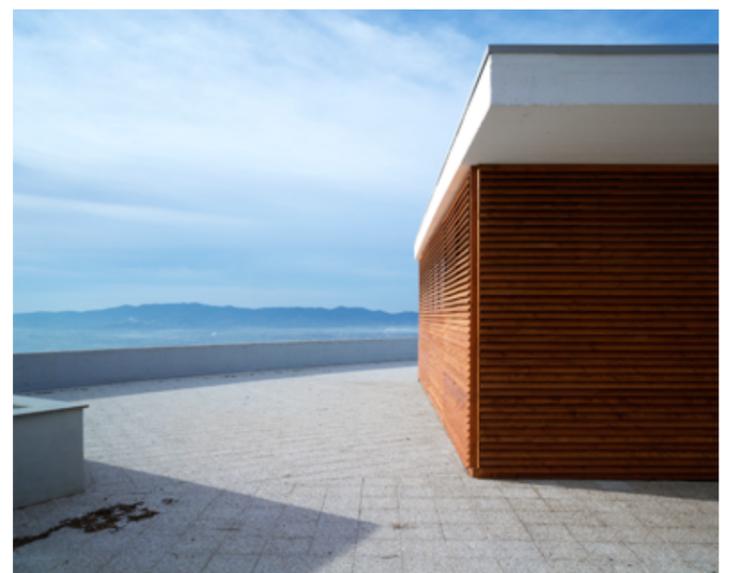
0 2 4 10m  
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## Montemurlo As Physical Home:

Two design strategies at Montemurlo stand out above all others: The rooftop farmyard-like spaces that provide access to the facilities below, and the massive, punctuated stone façade that evokes the dry stone walls of the region. Although contemporary in design expression, both features contribute significantly to a sense of familiarity—a place where a home might be made.

The topmost access level affords the opportunity for residents to walk unhindered in the open air, in a secure public place punctuated by a series of functional pavilions, some renovated from the existing farm buildings while others are completely new—readily identifiable through the use of lightweight construction, painted plaster and timber cladding. The overall effect resonates with the streets, lanes, farmyards and village squares of the region.

Image: Pietro Savorelli



The combination of heavy masonry openings and the interstitial space formed between the layered façades creates a permeable buffer between the inner and outer worlds.



Image: Pietro Savorelli



The space between facades provided shade for the interior and a protected walkway.

Image: ipostudio

Inside, the lower levels of the home offer framed views of the valley through a play of solids and voids. The external curved façade serves as a double-skin diaphragm: an inner glass-wall which permits open, visual connection and an outer masonry layer located at a distance of 1.80m from the first. Clad in a local stone taken from the excavation site, this massive wall is fundamental to the negotiated transaction between private and public, interior and exterior. This second outer layer operates on multiple levels. It is both shade device and light reflector, forming a protected walkway which residents can safely access.

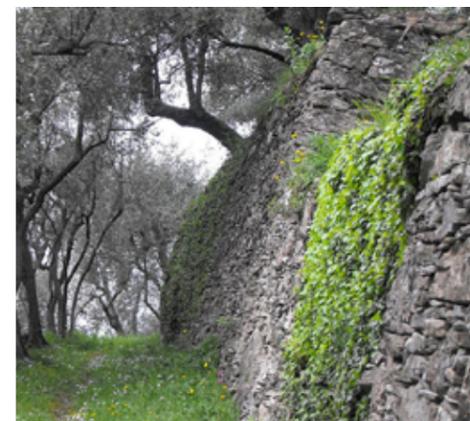
Seemingly random openings frame unique views of the surrounding countryside, making every single room identifiable, despite the repetitive nature of the radial plan configuration. The combination of distinct openings and the interstitial space, formed between the layered façades creates a permeable buffer between the inner and outer worlds, where the overall sense is one of discreet connection. This is a place where residents can feel simultaneously connected and protected.



Each bedroom has a unique set of openings in the external facade, assisting with the definition of a personal space.

Image: Pietro Savorelli

Stone retaining walls, traditional to the region.



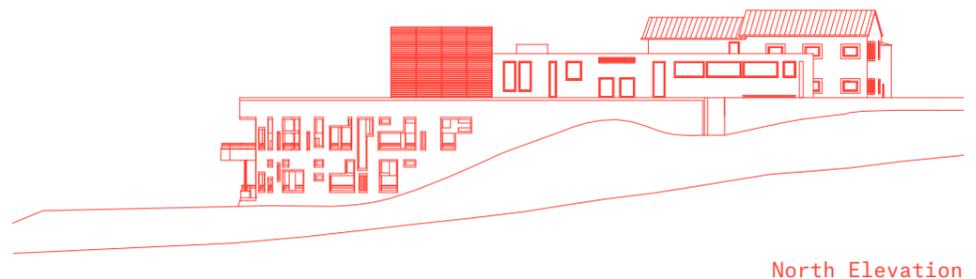
## The Social and Personal Home Connection With Others

When it comes to residential care, staff and family can mistakenly conceptualise the onset of old age as a loss of self, resulting in missed opportunities for social connection. In reality, the needs and desires of residents are, at their foundation, no different to our own. They desire to go outdoors, into the community and engage in stimulating conversations. <sup>5</sup> Where this is not possible, due to infirmity, then the community can be encouraged to come to the residents.

In Italy, residential care homes are encouraged to create strong connections with the wider community by adding attractive services such as a gym, cafe or in this case a day care centre to attract people from the surrounding neighbourhoods. For the architects at Montemurlo it was critical that “the prevailing character of openness and environmental integration require solutions that allow contact (especially visual) with life that takes place outside the building.”

However, the desire to connect has to be balanced with the need for privacy and security—the choice to withdraw inside or to reach out to others. In addition, different physical and mental need states of residents need to be accommodated. At Montemurlo, residents with dementia are not separated from other residents or the visiting community and, although a socially commendable strategy, the dead-end corridors, and clear glass balustrades are not ideal for independent orientation.

Plan

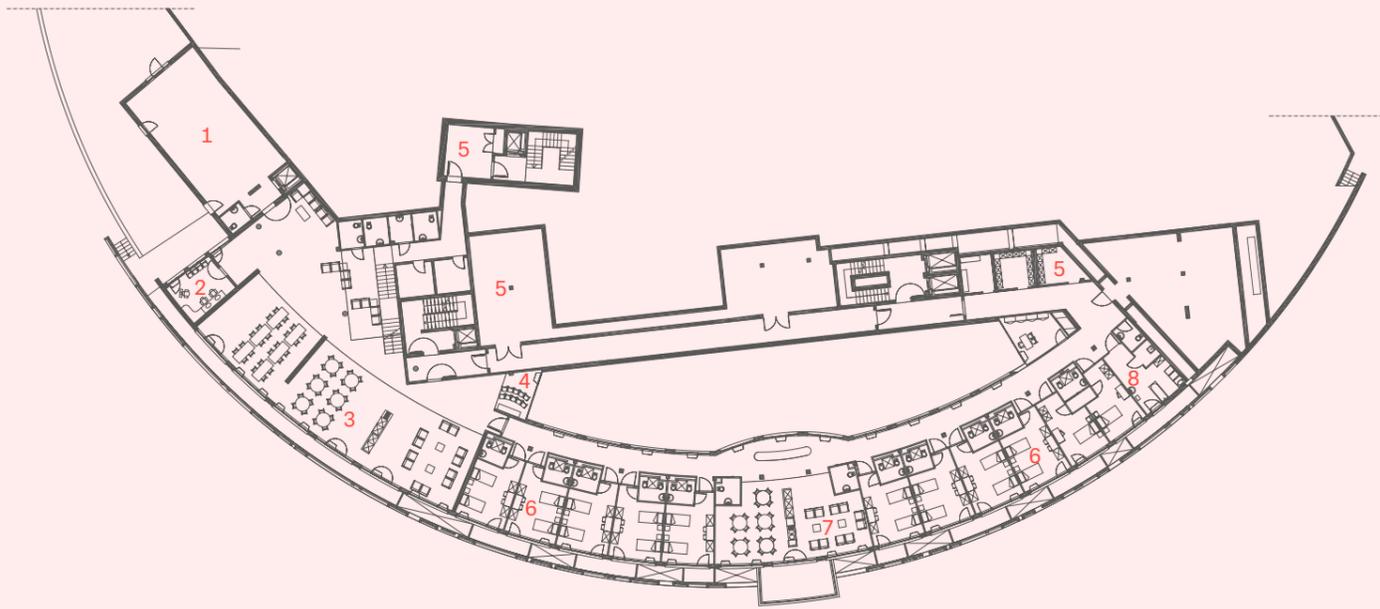


## Territory and Conflict

Human territorial behaviour can lead to conflict in closed environments. <sup>6</sup> In one research project involving over 300 participants in the United States, it was found that aged care facilities with a wide variety of shared settings and a strong policy of self-governance, exhibited fewer territorial conflicts than those with a limited choice of social spaces. A lack of autonomy among residents can enforce a sense of “lower social status”, creating a need for territorial claims over particular locations, dining tables and chairs. Conflicts arising from territorial claims can be diminished by supporting a resident’s desire for self-control. In addition, the availability of a variety of spaces: craft rooms, computer labs, libraries, gardens and exercise studio can provide residents with the capacity to find a place that fits their changing needs and desires. <sup>7</sup> The design at Montemurlo provides us with an excellent example of how those principles can be manifest in a series of layered, socially connected spaces and activities that combine to provide residents with that most precious of needs—the freedom to make choices. <sup>5</sup>

# 1

## Montemurlo: Level 1 Plan

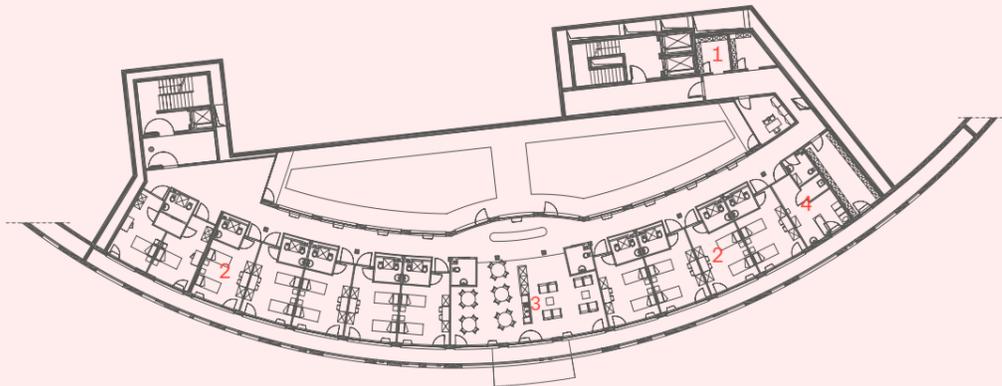


### Plan Key

- 1. Multi-purpose room
- 2. Hairdresser
- 3. Collective Activities
- 4. TV Room
- 5. Store
- 6. Bedrooms
- 7. Living and dining room
- 8. Assisted Bathroom

# 2

## Montemurlo: Level 2 Plan



### Plan Key

- 1. Store
- 2. Bedrooms
- 3. Living and Dining Room
- 4. Assisted Bathroom

**Residents are free to choose where and with whom they wish to spend their time.**

### Social Space

The design for Montemurlo adopts a layered approach to the organisation of three distinct but connected social structures, not unlike that of a family home. In the bedrooms, personal territory and degrees of solitude must only be negotiated with one other person. At the centre of each residential cluster is a semi-private social space that is used only by those who live on that level. The smaller scale living and dining facilities, and the availability of more private “niches”, allow residents to choose the degree to which they interact with other members of the “household”, while ensuring that there is, at least, some degree of connection. Finally, at the western end of level 1, a much larger social space is used for community wide special events and activities, affording the opportunity for residents to interact with the day-centre visitors. Residents are free to choose where and with whom they wish to spend their time.



Image: Pietro Savorelli

## Montemurlo Aged Care Facility

## Background Details



### Shared Bedrooms:

In Italy, although driven by organisational and economic imperatives, it is socially acceptable and quite common for residents to occupy shared bedrooms, with a mandatory maximum of two beds per room. The use of single rooms is limited to guests.

### Surface Data

Site surface:  
5,305 sqm

Overground surface:  
1,155 sqm

Underground surface:  
2,505 sqm

Total surface:  
3,660 mq

### Other Data

Overground volume:  
3,810 mc

Underground volume:  
8,770 mc

Total volume:  
12,580 mc

Total project cost:  
€ 5,073,000,00



### Food Preparation:

The kitchen was originally designed to act as a reheating facility for meals prepared off-site but was transformed by the operator into a fully functioning kitchen, as it was found to be more cost-effective and flexible. The main kitchen is located in the new building on level 0. On the lower levels there is a small kitchen at the centre of each cluster for preparing breakfast or refreshments between meals (tea, coffee, etc.)



### Personal Hygiene:

Residents have access to an assisted bath located in each cluster. Incontinence is managed through the use of diapers or pans depending on the needs of the individual residents.



### Laundry:

Laundry is carried out on site and the facility is located next to the main kitchen.



### Staff to Resident ratios:

Ratios vary greatly from region to region in Italy. In Tuscany it is 0.65 to 1, derived from the following formula: 1/10 professional nurses, 1/40 rehabilitation therapist, 1/2 technical assistants, 1/40 educators.

# The Dementia Competence Centre in Nuremberg— A Review of the Spatial Design

Case Study Two

By Dr Gesine Marquardt

# C2



**With the opening of the Dementia Competence Centre in Nuremberg in 2006, for the first time in Germany, an institution was able to provide a continuous chain of preventive, medical and therapeutic treatment for people with dementia. The Nuremberg Centre was specifically designed<sup>1</sup> to not only accommodate residents, but also to create strong connections with the community, through the guidance and training it provides to the carers of those still living at home.**

The design emerged from an architectural competition which was initiated by the care provider, Diakonie Neuendettelsau. The winning entry, by Mr Eckhard Feddersen of the Berlin-based architectural firm feddersenarchitekten, was subsequently built. The Competence Centre is located in a former military area of Nuremberg, which has been redeveloped for residential use. As is becoming common in Germany, this aged care facility is an integral part of the community. It is situated next to a childcare facility, allowing for interactions between the young and the old residents of the neighborhood and, thus, fostering intergenerational engagement.<sup>2</sup> Since most of the buildings surrounding the Competence Centre are also newly built, there are no immediate connections to the past lives of the residents in that neighborhood, a design strategy that has been found to be an important in dementia-friendly environments.<sup>3</sup> However, the view of the Nuremberg TV Tower is reported by staff as being important to the residents, because it reassures them that they are in Nuremberg.



Typical, assisted 'wellness' bathroom used by 10% of residents.

## Project Credits

### Architects:

Feddersen Architekten:  
Stefan Drees, Sebastian  
Brüning, Patric  
Birkenberger, Daniela  
Schwensow, Sandra Seifert,  
Klaus Günter.

### Structural Engineers:

Pichler Ingenieure, Berlin

### Services Engineers:

ist-energieplan, Müllheim

### Construction Site

management:  
Rückert Ackermann Weiß  
Architekten

### Construction Company:

Bauunternehmung GLÖCKLE  
Holding GmbH

### Landscape architect:

Harms Wulf, Berlin

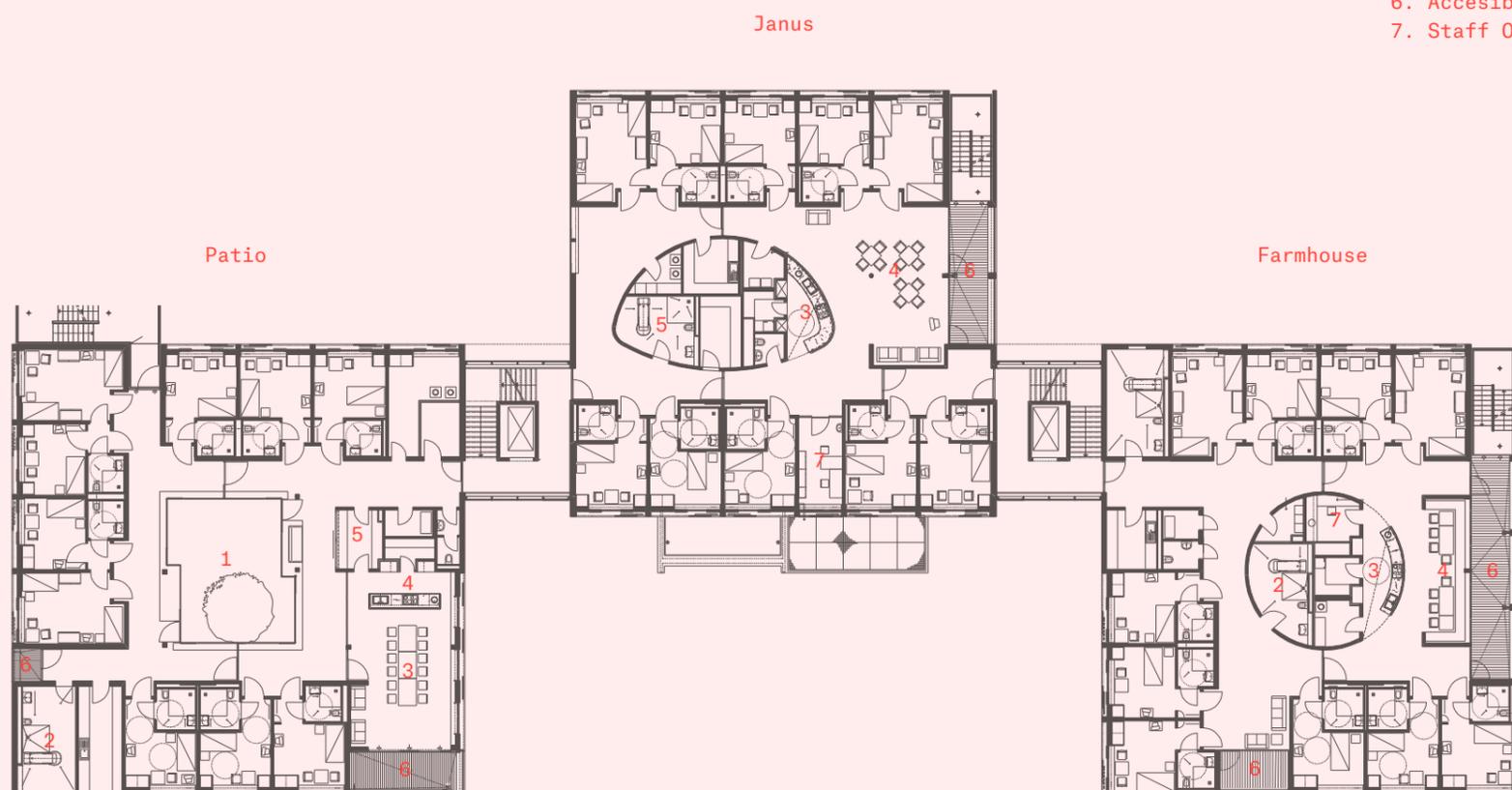
### Photography:

Ronald Grunert-Held

Note: Each unit has two shared bedrooms and eight single bedrooms.

### Plan Key

1. Void
2. Bathroom
3. Kitchen
4. Dining/Living
5. Bathroom
6. Accessible External Deck
7. Staff Offices



## Spatial Organisation

The residential component of the Competence Centre consists of three pavilions, connected to each other by fully-glazed staircases. At the time of writing there were 95 residents, over 50% of whom receive high care.<sup>4</sup> Each pavilion houses 12 residents on each of three levels. They are referred to as “residential groups”, and are similar to a family’s household, where most of a day’s activities take place. Households are connected to each other via the stairways, however, even though the residents are free to move within the building (with the exception of the residents of one group which are confined to their household) these connections are not used by many of the residents. The main reason is that, despite the fact that around 40% of current residents can move around their households, only about 10% are capable of moving independently between households. This represents a considerable decline since the center was first opened. Further, there are very few orientational cues to be found outside the households, making it difficult for the residents with dementia to purposefully find their way from one to another. This situation may be a benefit under circumstances where external wandering may be undesirable or even dangerous. However, once inside, each of the households has a unique identity, created by distinctly different spatial and interior designs. Research indicates this strategy can prove helpful to inform residents on their whereabouts and may also foster a feeling of belongingness to their individual household.<sup>5, 6, 7</sup>

Furthermore, each residential entrance employs the use of a “transition zone”, where the familiar sight of a wardrobe with a rack for coats and hats and some corresponding vintage items helps residents to identify this area as the entrance to a household. If residents are to be discouraged to leave their household, large curtains in the color of the adjacent walls are closed, thus hiding the exit doors from view. However, as has been shown in previous studies, this intervention does not work for all residents,<sup>8, 9</sup> especially the more mobile ones, some of whom are reported to just pull the curtain aside and leave through the exit door.



View of main Entrance Courtyard.

There are three different types of spatial layouts found in the households. They are called *Patio*, *Janus* and *Farmhouse* (to be seen on the floor plan from the left to the right). The *Patio* type has an inner courtyard which serves as a safe outdoor space for the residents of this group, which are not allowed to leave their household by themselves. In the

upper floor, the communal spaces of the household are light-filled because of the large-format interior glass façade. The circulation area is organised as a loop around the inner void. From this path the residents’ rooms are accessed. The staff stated that this layout and the glass façades are helpful for their work as they can oversee the whole household. Some residents have had issues with the view through the interior glass façade. Staff have reported that residents sometimes feel uneasy about the blurred view of other people moving about on the other side of the glass because they were unable to identify that hallway as a part of their own household.

Compared to the *Patio* type, the *Janus* households in the middle are not as bright but, because more solid walls enclose defined spaces, staff report that the interior space seem to be more comprehensible to the residents. These observations are supported by research on the spatial syntax of the home environment of people with dementia.<sup>10</sup>

Operations and service facilities, as well as a therapeutic bathroom, are located at the centre of this household, however, only 10% of the residents are reported to use this bathroom.<sup>11</sup> The truncated shape of the core opens up to create the main communal space in each household—an informal sitting place where more quiet activities with small groups of residents take place. In the third household type—the *Farmhouse*—the design picks up features of the local traditional rural lifestyle. For instance, the doors to the residents’ bedrooms are designed similar to “stable doors”, where the lower and the upper part of each door can be opened and closed separately. Although the idea of confining the private area by closing the lower part of the door while allowing for visual and acoustic access by leaving the upper part open is intriguing, the residents are reported to not make much use of this feature. The interior service area of the *Farmhouse* households is circular in shape and, being similar to the *Janus* type, it also offers a small informal sitting area in addition to the larger living-dining space.

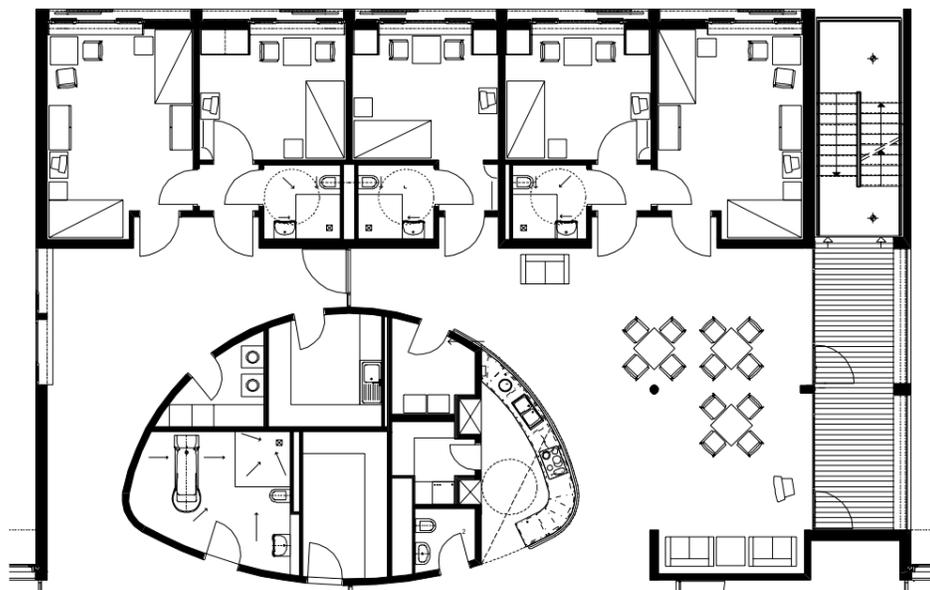
**Regardless of layout type, the center of activity in each household is an open, homelike kitchen where residents can be involved in everyday activities.**



‘Stable door’ style access to bedrooms are not often used by residents.



Household Kitchenette.



## Social Participation

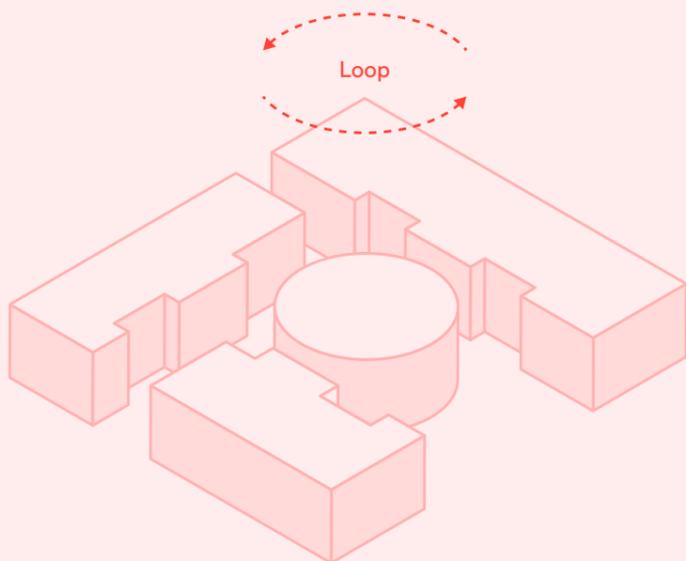
Regardless of layout type, the center of activity in each household is an open, homelike kitchen where residents can be involved in everyday activities—a strategy that is supported by research findings,<sup>12, 13</sup> particularly when the kitchen opens directly onto the dining area. Although only one or two residents in each household are able and interested in participating in the housework, activities such as baking and light cleaning are performed regularly, as they are included in the therapeutic concept. There is no central dining area in the competence center, but all the meals are distributed by a caterer to the households. All mealtimes are shared by the residents and eating alone in one’s room is discouraged. These concepts of social participation implemented in the Nuremberg Competence Centre have been identified in previous research<sup>14, 3, 15, 16</sup> as significant contributors to the creation of a homelike environment.<sup>17, 3, 15, 16</sup>

Adjacent to the open-plan kitchen is a living-dining area where residents not only eat their meals, but also spend a considerable amount of time every day. At all times, a staff member is present at this place. For administrative duties, especially the care documentation, a private staff office is located in the operations and service facilities of each household. Reports indicate that staff make good use of this office and appreciate the ability to focus when undertaking administrative duties.

Through the combination of these spatial and staffing features, the dining-living area becomes a central anchor point within the household. In previous studies,<sup>18, 19</sup> these anchor points have shown to support the resident’s spatial orientation to a great extent. The resulting improvements in wayfinding abilities are not only found when the residents are aiming at locating the dining-living area but they also support the residents’ overall orientation within their living unit.

## Wayfinding

The block that forms the central anchor point in all households also creates a looping circulation area to access the residents' rooms. In larger entities with more than 12 residents this design has been shown to interfere with the wayfinding abilities of the residents.<sup>18</sup>



Nuremberg: Farmhouse

Furthermore, long corridors have been associated with anxious behavior, decreased vitality, and motor dysfunction.<sup>20</sup>

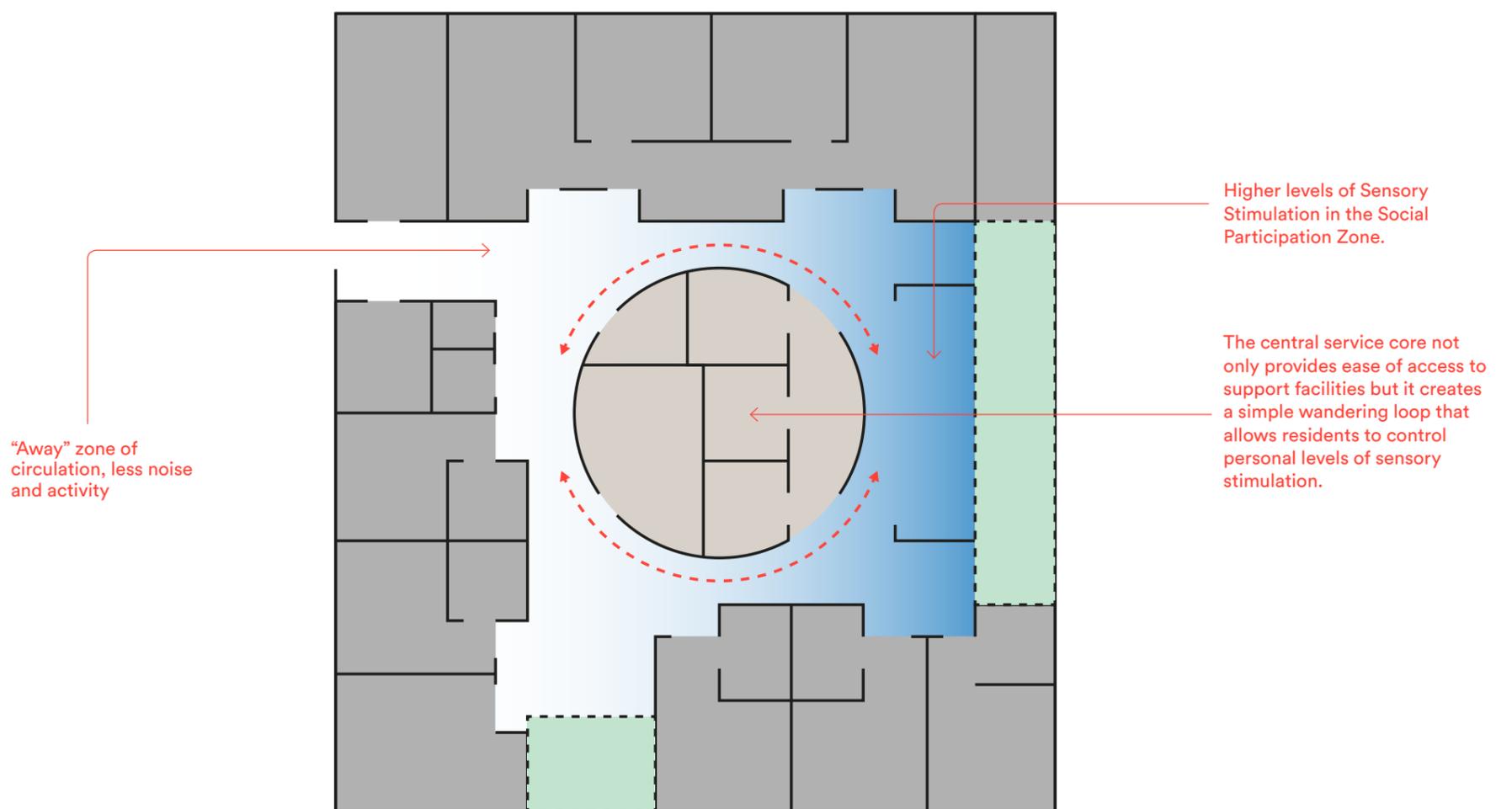
However, in small-scale units the loops do not constitute a problem for the residents' orientation and in the Nuremberg facility they are reported to be frequently used by the residents as a wandering path. The reasons are not fully clear from available research, although it is hypothesised that the shorter loop-time means that residents can become re-oriented more quickly and therefore less agitated about feeling lost.

Objects that are placed at significant places in the nursing home environment can support the residents' wayfinding abilities to a great extent, as a number of previous research studies<sup>5, 19</sup> has found. At the Competence Centre in Nuremberg, special attention is given to the doors of the residents rooms. They are set back from the walls, forming niches that serve as semi-public transition areas to the private (or semi-private) bedrooms. The indented walls are given an

individual color or patterned wall paper, thus aiming at increasing their distinctness. Further, next to each door there is a wooden panel that can be personalised by the residents. Here, the names of the residents and, in some cases, photographs of their younger selves can be found. A small display unit allows staff to place personal objects near each door, an idea that has been identified in previous studies<sup>21, 22, 23</sup> to support residents' wayfinding abilities. However, the staff at the Competence Centre indicated that only very few residents seem to make use of these visual cues.

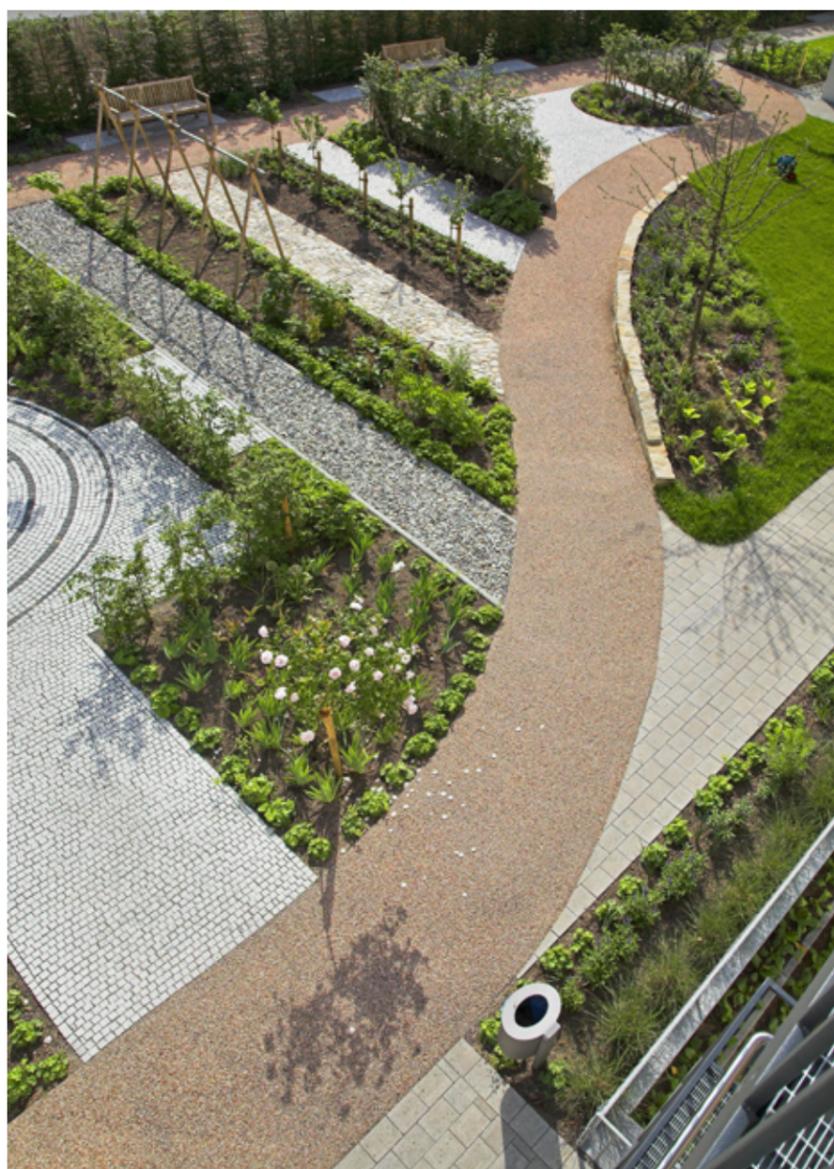
Research indicates that tactile cues may be helpful for residents with severe dementia.<sup>24</sup> In the Nuremberg facility, they are reported to make use of the wandering paths by holding on to the handrails. Further, the surfaces of the interior service areas in the *Janus* and *Farmhouse* household types are fitted differently. Hand-trowelled plaster, timber panelling and even exposed masonry provide residents with tactile cues.

## Wandering and the control of sensory stimulation



- Legend
- Bedrooms
  - Staff Facilities
  - Outdoor/Garden
  - > Loop Path

By providing direct access to exterior environments, the residents of these households can make independent use of the outdoor areas, a fact that has been shown to benefit a resident's sense of autonomy.



Overhead view of the Kitchen Garden

## The Garden

Access to the outdoors has been shown to benefit residents with dementia as it can reduce over-stimulation, stress, and agitation.<sup>25</sup> Further, a reduction in wandering behavior, sleep disturbances and overall disruptive behaviors have been found.<sup>26</sup> Further research<sup>27</sup> has shown that staff members greatly appreciate outdoor parks and gardens and find them important to everyday life.

The Competence Centre in Nuremberg features a garden which offers many activities to the residents. Raised beds allow gardening work for those who are unable to bend over to the ground. Growing local fruit, such as raspberries, may bring back memories of past times. Also, quiet sitting areas for intimate talks with family members or for contemplation are to be found in the garden. The outdoor area is accessible from the households on the ground floor via their living-dining area. By providing direct access to exterior environments, the residents of these households can make independent use of the outdoor areas, a fact that has been shown to benefit a resident's sense of autonomy.<sup>28, 18, 29, 30, 31</sup>

Unlocked doors to a safe outdoor area have been found to lead to decreased agitated behaviours.<sup>32</sup> From the upper floor, only the residents that are able to move throughout the building can access the garden independently. However, each of the household features a balcony which is reportedly used by the residents to a great extent.

## Conclusion

The Nuremberg facility has been in service for almost eight years now and, the care providers have expressed great satisfaction with the concept, so much so that the basic idea of the households will be repeated for two new nursing homes designed by feddersenarchitekten and being built in Bavaria. At the time of writing, the first of the new facilities, in the town of Forchheim, has been completed. Groups of 12 residents will be accommodated in households according to the specific needs of individuals at different stages of dementia. However, the spatial independence of the Nuremberg design has presented some problems from the point of view of staff management. Due to their layout, all of the households require a dedicated staff member at all times and this presents a great challenge at times of temporary staff shortages, i.e. when a high number of staff are away sick. Given the increased levels of immobile, high-care residents, in the new Bavarian project, there will be one central care area from where staff can quickly move from one household to another. It remains to be seen if the more complex wandering paths that result from these changes will continue to be used as frequently as the Nuremberg facility. However, residents will continue to have independent access to an atrium courtyard and a protected garden.

The Nuremberg Dementia Competence Centre clearly illustrates that a successful design strategy affords residents with as much independence as possible, based on their level of competency. It is also evident that every architectural project has to balance occupant welfare with operational needs and, if we are to successfully negotiate between those territories, then we need more detailed information about the factors that are critical to that success. The Nuremberg Dementia centre represents a contemporary transformation in how we see those of us who suffer from dementia, not as problems to be solved but as people with understandable needs and capabilities. The hypotheses that underpin this project are worthy of further investment in ongoing and rigorous, in-situ research.



Proposed Aged Care Facility in Bavaria  
by Feddersen Architekten.

## Nuremberg Aged Care Facility

## Background Details



### Shared Bedrooms:

The care provider reports that the household ratio of two shared rooms to eight private rooms meets their current needs, however, they also acknowledge the increasing general tendency in Germany towards single rooms.



### Food Preparation:

Lunch is supplied by external providers, while breakfast and dinner are prepared in the households.



### Personal Hygiene:

Although just 10% of the residents are reported to use the “wellness” bathing facilities, the ensuite showers are used on a daily basis.



### Laundry:

All laundry is outsourced.



### Staff to Resident ratios:

No direct information is available from the care provider, however, German Law “Pflegeversicherung” regulates staff-to-resident ratios. As a general rule, three levels of care are based on staff time per resident and those levels of care are assigned by a Medical Review Board.

**Care level 1:** 90 Min. total time- thereof 45 Min. for basic care.

**Care level 2:** 180 Min. total time - thereof 120 Min. for basic care.

**Care level 3:** 300 Min. total time – thereof 240 Min. for basic care.

The outcome of all care minutes from all residents in the unit/household combined (in hours) is the total staff time required for each care unit/household. Individual care providers calculate how many people are needed to meet the requirement. Staffing will be different depending on time of day e.g. more staff are needed in the morning than at night etc. Furthermore, 50% of staff are required to be registered nurses. Local variations will apply. There are 16 states in Germany and each state has their own aged care legislation.

### Project Data

Project Cost:  
€7.9 million  
(Residential Component)

Gross Floor Area:  
5,928 sqm  
(Residential Component)

# “Smart Homes”: Digitally Augmented Residential Settings to Support Ageing

The segment of the population 65 years of age or older continues to grow as life expectancy increases, and as technology advances, we are faced with new opportunities to support older adults to maintain their independence in their homes and in residential care. The concept of the “smart home” refers to residential settings where the technology is embedded in the infrastructure facilitating passive monitoring of residents without the need for individuals to learn how to operate a device. Such passive monitoring allows for tracking of overall activities of daily living and mobility patterns that could ultimately enable the detection of abnormalities or pattern trajectories that call for an intervention in order to avoid adverse or catastrophic events.

In addition, these systems will have a significant impact on the layout of residential care facilities, allowing more “open” environments for residents and staff to move through.

The capacity to automate these environments can extend to the control of doors, lifts, heating, lighting and even noise levels, allowing staff to tailor care management strategies to the needs of each individual resident.

→



“Smart home” systems utilise primarily sensor technologies (for example, motion, pressure and heat sensors, sensors detecting electricity and water consumption but also restlessness in bed or respiration). Table A highlights the functionality and purpose that smart home technologies can currently serve, with the specific purpose of protecting the resident’s autonomy and dignity. Table B provides an indication of emerging technologies in this field.

Table A:

## Current Residential Technologies

A

EBD does not endorse any of the following products, but offers them only as examples of the kinds of technologies that are currently available and used in the aged care sector.

1

### Physiological monitoring

Sensor-based tools that passively measure vital signs. Example: Bed sensor that measures respiration, restlessness at night, sleep interruptions.

PRODUCT EXAMPLE

→ Motionlogger Bedsensor



2

### Safety monitoring and assistance

Stove sensors (combining heat and motion sensors) to detect and distinguish between meal preparation and having left the stove on for too long.

PRODUCT EXAMPLE

→ Stove Guard



3

### Security monitoring and assistance

Sensor-based system that captures level or intensity of activity that requires physical motion, number of visitors or if abnormal/unusual patterns of activity are recorded.

PRODUCT EXAMPLE

→ Avtech Motion Sensor



4

### Social interaction monitoring and assistance

Sensor-based systems that track number of visitors (e.g. using door sensors and motion sensors), time inside and outside the home, sedentary behavior.

PRODUCT EXAMPLE

→ Schlage RS100HC V N N SL Home Door and Window Sensor with Nexia Home Intelligence (Z-Wave)



5

### Cognitive and sensory assistance

Automated features that operate in the background and trigger warnings, alerts and reminders. Example: Automatically lighting a path when one gets up in the middle of the night, having a recorded message prompt a resident to go back to sleep if they open the front door at night, providing cues as to who is calling.

PRODUCT EXAMPLE

→ Xodus Motion Sensing Light



**Table B: Emerging Technologies**

**B**

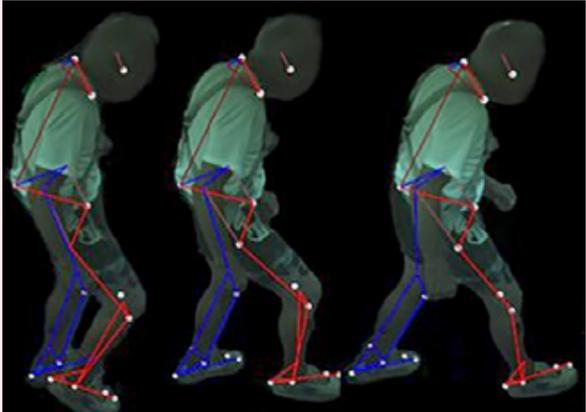
EBD does not endorse any of the following products, but offers them only as examples of the kinds of emerging technologies that could be used in the aged care sector.

**1**

**Functional monitoring/Emergency detection and response**

Gait monitors that detect falls or near falls, sensor-based systems that detect sedentary behaviour.

PRODUCT EXAMPLE  
→  
McKinnon Laboratory-  
University of Minnesota

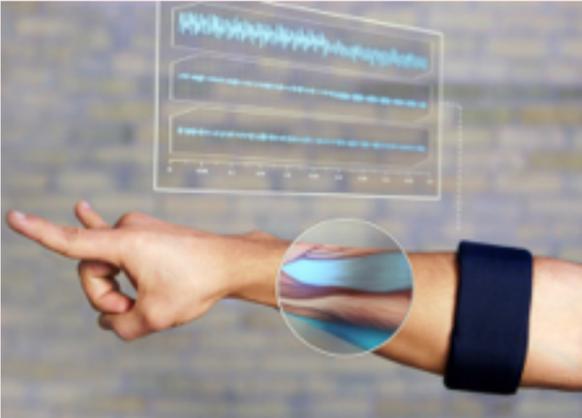


**2a**

**Wearable sensors**

Current devices worn by residents allow care providers to inconspicuously monitor location, gait, trajectory and even some biorhythms such as heart-rate, skin temperature and blood pressure. Such new devices can potentially allow the wearer to automatically operate doors, windows, TV etc using proximity and gestures.

PRODUCT EXAMPLE  
→  
Myo – wearable gesture recognition device



**2b**

**Wearable sensors**

Wrist-worn sensors can measure the wearer's normal patterns of life. They require an automated monitoring service that analyses the patterns and alerts carers when something is wrong.

PRODUCT EXAMPLE  
→  
Care Predict Motion Sensor

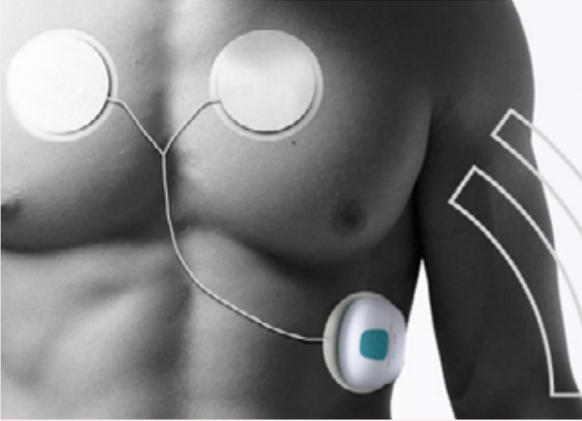


**2c**

**Wearable sensors**

New devices such as Zensor and Vpatch from Intelesense are lightweight and highly mobile. Records heart rate (USB download to full ECG standard), O2 levels, respiration, skin temp and motion while resident is moving around. Includes wireless transmission of detected arrhythmias.

PRODUCT EXAMPLE  
→  
Zensor mobile biorhythm monitors



**3**

**Robots**

Mobile, remote telepresence robot allows resident monitoring by staff and remote visiting by friends and relatives.

PRODUCT EXAMPLE  
→  
VGo



## Case Studies

There are currently numerous smart home initiatives with an ageing focus globally, not only within the academic research space but also implemented as business models for retirement communities and assisted-living facilities. Some of the earlier initiatives include the Center for Future Health at the University of Rochester in the United States that developed a Smart Medical Home<sup>1, 2</sup> as a highly controlled environment including infrared sensors, biosensors, and video cameras. Another of the earlier initiatives that also helped introduce the concept of smart homes to health sciences was the Aware Home at the Georgia Institute of Technology<sup>3</sup> which explored ubiquitous computing technologies that sense and identify potential crises, assist a senior adult's memory and track behavioural trends. Researchers from five countries (the UK, Ireland, Finland, Lithuania and Norway) joined their efforts for the ENABLE project,<sup>4</sup> which promoted the wellbeing of people with early dementia with several features such as a locator for lost objects, a temperature monitor and an automatic bedroom light. In 2004, an innovative independent living environment called TigerPlace<sup>5</sup> was built as a special facility where residents can age in place with care provided by a collaborating home care agency with registered nurse care coordination services on site. Motion, heat and bed sensors, gait monitors and traditional telehealth monitoring devices are used in the individual apartments to monitor residents' wellbeing over time. Finally, as part of the HEALTH-E (Home-based Environmental and Assisted Living Technologies for Healthy Elders) project<sup>6</sup> at the University of Washington, researchers have installed various sensor technologies in apartments of older adults who live in retirement communities in Seattle. The sensor technologies in this project include regular motion sensors to detect how one moves from one room to another in the home, or within a room, as well as infrastructure mediated sensing, namely an electricity sensor that can detect electricity consumption by electricity source, and a water sensor that detects water consumption by each water source. These features allow the detection of activities such as meal preparation or bathroom visit with the level of detail (e.g., which faucet or electric device was used when and for how long) that simple motion sensors cannot provide. The comprehensive information generated by these three types of sensors enable the assessment of overall mobility and activity level in the home. Additionally the

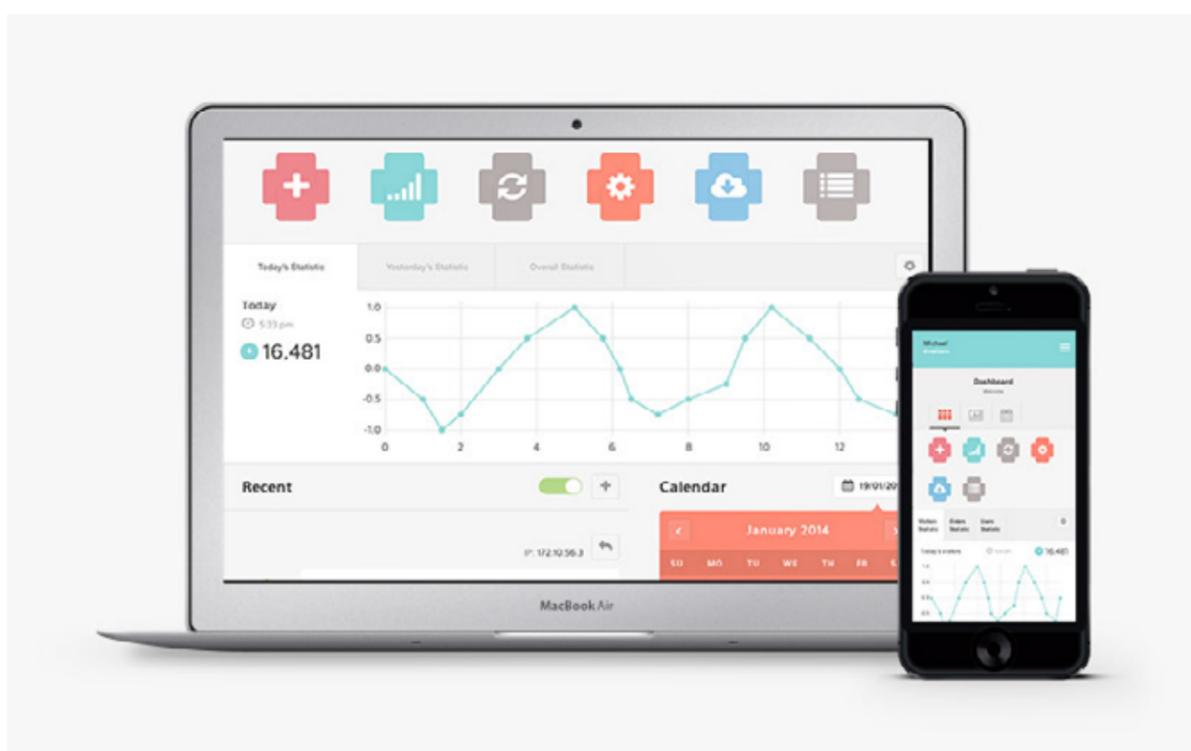
“Complex data analysis and pattern recognition techniques allow not only the detection of activities but also potential changes over time calling for a timely intervention to prevent an adverse event.”

integration of door sensors can provide information on visitors and time spent outside the home. Complex data analysis and pattern recognition techniques allow not only the detection of activities but also potential changes over time calling for a timely intervention to prevent an adverse event (for example, if data indicate a more sedentary behaviour over time, or an increase in bathroom visits at night or other sleep interruptions, less number of meals prepared etc.)

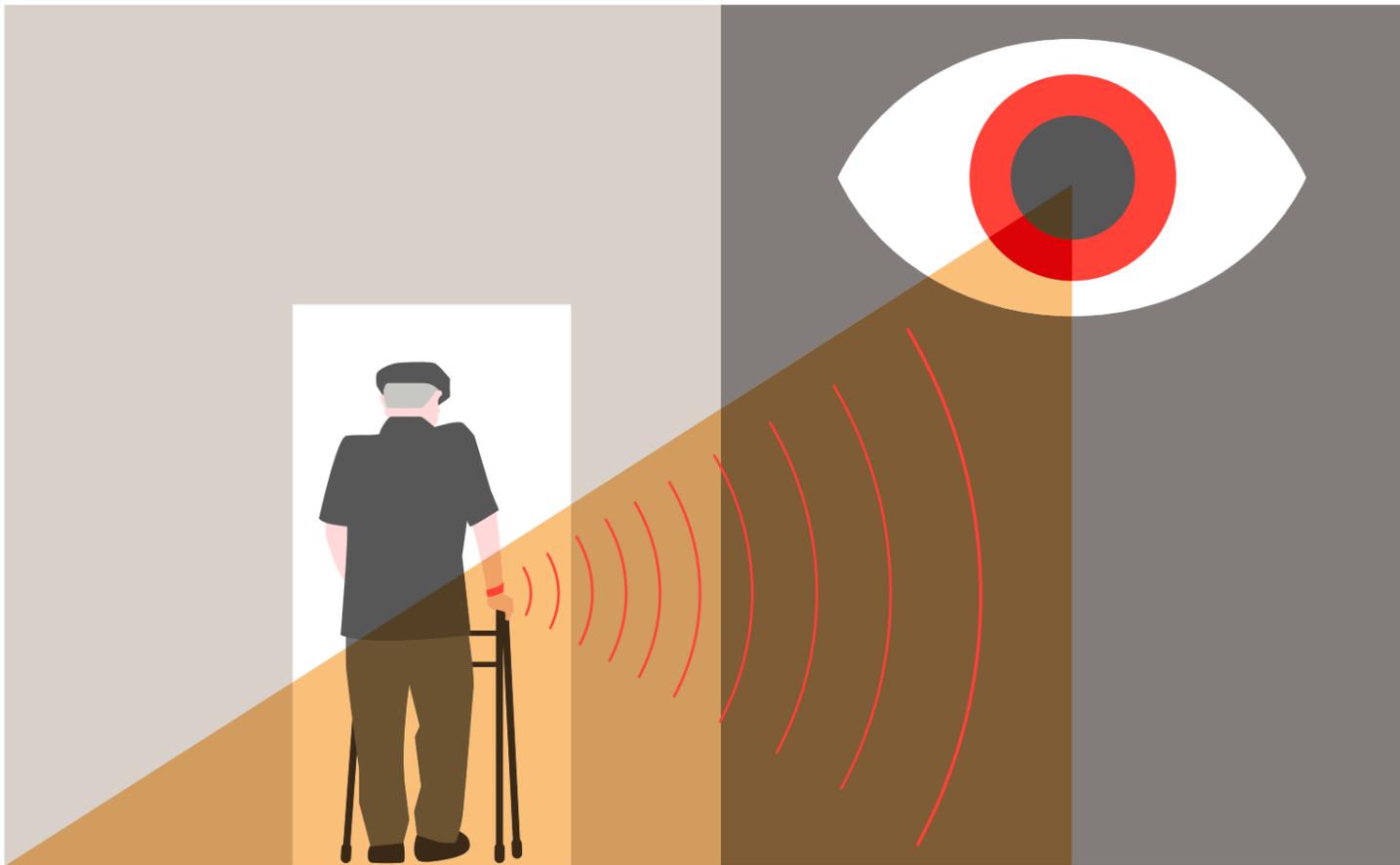
The HEALTH-E project has identified several cases where technology was proven helpful. One case included the detection of a urinary tract infection for a participant as was manifested by an unusual and significant increase in bathroom visits during the night (and overall increased restlessness at night). Another example included a resident who showed increased sedentary behaviour during the day with an increased time in bed and sleeping in the morning and afternoon. The resident decided to share the data with her health care provider and this led to an adjustment in her medication plan. Overall, participants had no concerns about privacy and indicated that they very quickly forgot the sensors were installed in their homes (as one participant noted, “after a couple of days I forgot until you called me again [about the study]”). None of the participants withdrew from the study, and during regular periodic interviews participants expressed no concerns for privacy or confidentiality, they did however emphasise that they would like to choose with whom they share data generated from the smart home system.

## Adoption

The adoption of smart home technology depends to a large extent on acceptance of the concept by older adults themselves. There are a number of reasons why people may be hesitant to adopt smart homes. Such research must be placed in a conceptual framework in order to generalise consumer perceptions and systematically inform the design and implementation of smart homes. In this context, the concept of obtrusiveness, defined as “a summary evaluation by the user based on characteristics or effects associated with the technology that are perceived as undesirable and physically and/or psychologically prominent”,<sup>7</sup> needs to be examined. Obtrusiveness in this framework includes multiple constructs such as the stigma that such technologies may carry for individuals, its impact on aesthetics in the residence, potential physical dimensions of obtrusiveness, concerns about maintenance and sustainability. A significant component of the concept of obtrusiveness is privacy. It is often assumed that systems capturing detailed information about one's daily activities may not be welcome in one's home due to privacy concerns; yet this claim has not been confirmed with older adults. Older adults embrace “smart home” technologies when they see a purpose and need.<sup>8</sup> Studies suggest that older adults are often willing to compromise certain levels of privacy to gain support in remaining independent.<sup>9, 10</sup> This type of conditional reasoning determines in many cases the acceptance of privacy invasive technologies, where a device that may be considered to be intrusive, is likely to be accepted if it is viewed as necessary to support a need.<sup>11</sup>



Typical user-friendly interface from mobile monitoring device.  
Image courtesy of 'Care Predict'™



## Ethics

The research and development agenda for smart homes must include ethical considerations for their design and implementation. Implications beyond the privacy ones that we already mentioned, including those for social relationships and interaction, and over-reliance on technology, must be fully examined. Moran was one of the first to pose crucial questions about the social impact of smart technologies.<sup>12</sup> She stated that:

*“The introduction of advanced technology into the home has the potential to change qualitative and quantitative aspects of relationships between household members, as well as the role and function of the home and its relationship with the wider environment.”*

To what extent do ongoing passive monitoring systems remove choice and control from residents as they learn to rely on automation? There are concerns that smart homes may result in a reduction of social interaction, or may provide tools that substitute for personal forms of care and communication. We have to consider when discussing the design of smart home applications the warning by Wyde and Valins, of creating “societies of high tech hermits.”<sup>13</sup> In this context one needs to recognise the potential difference between smart home technology used in an individual residence and that used in a residential care facility. In the latter case, the use of technology may actually encourage social interaction within that communal setting.

The extent to which smart homes lessen the sense of personal responsibility on the part of the residents or their caregivers must be weighed against real or perceived benefits. Family caregivers may become less vigilant in monitoring health changes in their loved one. Furthermore, we need to examine eligibility criteria and resident characteristics or clinical conditions that may be more suitable for smart home interventions than others. As Stip and Rialle point out,<sup>14</sup> the issues of individual freedom, personal autonomy, informed consent, and confidentiality have to be examined in the context of the target population. They point out applications for residents with schizophrenia, a condition that causes distortion of reality in the form of delusions of persecution, and highlight the likelihood that surveillance technologies may exacerbate such symptoms. Similarly, while passive monitoring may be most beneficial for people with dementia or other cognitive limitations to ensure their wellbeing and prevent wandering or other accidents, often the decision for this intense monitoring is made by a relative or friend who has decisional authority. The diffusion of smart home technologies calls for effective Advance Care Planning that would address the use of such technologies or other monitoring digital devices. People in early stages of dementia are concerned about the growing lack of autonomy that they often mentally associate with the diagnosis. In these cases home-based technologies may function as cognitive orthotics to prolong independence at the setting of their choice. A conversation about the types of technologies, frequency of and stakeholders involved in monitoring as the disease progresses could potentially address some of these concerns.

As the field evolves, it becomes apparent that while earlier applications focused on extensive monitoring of residents where the results of data mining became available to health care providers only, recent trends pursue a perhaps more patient empowering approach as systems allow older adults to be in charge of the frequency and terms of monitoring, and to determine access rights for the resulting datasets. The inclusion of family members in these processes introduces new roles and dimensions for distant caregiving.

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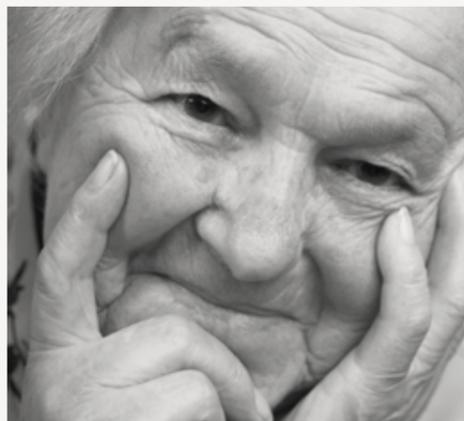
**“The extent to which smart homes lessen the sense of personal responsibility on the part of the residents or their caregivers must be weighed against real or perceived benefits.”**

## Conclusion

The concept of digitally-augmented homes in the context of health care is relatively new and requires further research to address important questions, including those of health outcomes, clinical algorithms to indicate potential health problems, user perceptions and acceptance, and ethical implications. Scientific literature is lacking evidence of the effects of smart homes on health outcomes, including earlier disease, illness, and injury detection and intervention. We are lacking studies addressing the effect of a smart home on acute episodes requiring emergency care or a possible delay or prevention of nursing home placement. Ultimately, such questions will necessitate large randomised and controlled studies, possible only with more widespread penetration of smart homes.

The growing field of “smart homes” highlights the emerging role for information technology in supporting ageing and promoting quality of life for older adults. As technological advances enable sophisticated home-based solutions, we need to ensure that the design and implementation of such applications for older adults are not determined simply by technological advances but by the actual needs of older adults and their families.





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## Design Principle 1: Facilitate Orientation



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## Design Principle 5: Provide a home-like and familiar atmosphere



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## Design Principle 6: Balance between the private and the Social

## Notes/References



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## Case Study 2: The Dementia Competence Centre in Nuremberg— A Review of the Spatial Design



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## Article 2: "Smart Homes": Digitally Augmented Residential Settings to Support Ageing