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Understanding the Spatial Requirements that Facilitate Personal Leisure Activities of the High-Needs Elderly

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ABSTRACT

The growth of the ageing population and the desires for ageing-in-place have resulted in an ever-increasing need for housing that can support the independent living of the elderly with care needs. As impairments and care needs increase, spatial use typically changes. However, there is limited information on how to accommodate leisure activities and spatial use in private dwellings to inform housing design. Through an ethnographic investigation of 30 high-needs elderly people living independently, patterns of spatial use for personal leisure activities were established. Seven key themes for residents' perceptions were revealed, which include; comfort in posture, access to sunshine and warmth, facilitating activities to occupy residents, views to outside, control for doing everything from one space, and keeping active. In the design of housing for the high-needs elderly, greater attention should be given to the micro-environment of the main sitting space, to improve occupant control while enhancing comfort and warmth. This paper provides key considerations for housing design, which will help elderly people continue their fulfilled life in their own home as long as possible.

1. Introduction

The extension of life expectancy recent years has resulted in the prolonged period when people live with disability and care needs^[1,2]. In many countries, including New Zealand, residential care is a major accommodation option when some level of care is required^[3]; however, the policy for ageing-in-place calls for staying in one's own home as long as possible, without entering residential care^[4,5]. While many elderly people wish to age in their current dwellings, the lack of suitability for those with impairments would require adaptations/

modifications and maintenance services for both the garden and the property in the future^[6-8]. With these limitations, combined with financial concerns, many anticipated the need to move to a smaller house^[6-8], but wanted to live independently in the community^[8]. With the rapid increase in the ageing population there is an urgent need for housing that can support independent living in the community, even after care needs arise. To ignore this will mean both a decreased quality of life for the elderly, but also higher government costs for residential care facilities.

The quality of life of the high-needs elderly has been

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studied internationally and research finds that; As dependency increases, a decrease in quality of life is often experienced^[9-11]. Maintaining activities that are interesting and meaningful to the individual is a significant contributor to the quality of life for this cohort, along with other factors such as the maintenance of Personal identity, the maintenance of important relationships and the provision of care that facilitates autonomy and individual needs^[9,10]. These activities not only contribute to greater happiness, they also provide stimulation and help with the prevention of falls or physical and mental decline^[12-14].

With the recently increasing attention to the importance of engaging in their meaningful activities^[15-18], research has stressed the importance for activities and spaces to be designed to suit residents' particular interests and to facilitate choices for their participation^[10,19,20]. These requirements have been adopted in many OECD standards. For example, National Care Standards in Britain recommend that communal spaces in care homes include rooms where various social, cultural, and religious activities can take place^[21]. With a variety of spaces, residents typically have higher levels of active behaviour^[9,22,23].

Recently, providing options for undertaking meaningful activities *in individual space* has been receiving increasing attention^[10,19,20]. The private housing environment has a great impact on individual's meaningful activities, as space used for activity becomes more restricted in old age, with activities more likely occurring within their private dwelling^[15]. Greater difficulties with mobility often result in different spatial uses. For example, Hale et al. reported that, in private dwellings, a 'reorganisation of space', such as 'placing necessary items conveniently to hand, on small tables on either side of the individual's chair, to ensure as little movement as possible' often occurs in order to afford as much control as possible^[24].

In contrast to the great attention to the provision of communal spaces, there is limited information on the design requirements of individual spaces particularly as they relate to the micro-environments of the sitting space. Some design guidelines only require the day area large enough to contain a table and chairs^[25]; and others include requirements for the layout of a comfortable chair near a telephone and a TV, as well as requirements for space accommodating furniture such as a bookcase, TV, CD/music player stand and a computer desk^[26]. For designers, these requirements are too generic to inform the effective design of the sitting space of high-needs residents. Information is also lacking regarding the kinds of activities that the high-needs elderly typically enjoy, and the spatial requirements to facilitate them.

In order to design housing that improves the quality of

life of high-needs elderly residents, greater information is needed on the requirements of private space that facilitates their personal activities in their individual dwellings. This paper aims to clarify those spatial requirements needed to facilitate personal activities, limiting the scope to leisure activities, but excluding daily basic activities such as cooking, showering and sleeping.

2. Methods

An ethnographic survey for built environments that improve quality of life, was conducted of 30 elderly people in the Wellington Region in New Zealand, who consisted of 17 residents of retirement villages, 6 from public-sector rental housing and 7 from private-sector rental housing. Participants were selected from those who were 70 years and older and received care in daily activities from professional caregivers in their own house. Through documentation of the housing environment, semi-structured interviews and single-day observation of elderly residents, data on their day-time activities, the space and their perceptions were collected. Ethics approval was obtained from the Victoria University Human Ethics Committee (approval number: 23243). The consent was obtained from all participants prior to the data collection.

The collection of housing environments included the measurement of the layout of the buildings and rooms and the furniture and fixtures, which were collected in plans, sketches and field notes. Photographs were also taken. Semi-structured interviews were conducted to collect resident's perceptions and experiences. To collect the in-depth data, questions 'which are open (rather than closed), and which do not make too many assumptions towards particular answers^[27]' were chosen. Questions relating to residents' personal leisure activities included "Can you tell me about your most important activities?", and "Can you describe your favourite space in this house, and why?" In the event that they could not think of answers or in order to delve into the topic, some prompts and sub-questions were prepared for each question; particularly, it was deemed useful to use prompts such as 'Can you tell me a bit more about that?'^[27]. Interviews were conducted in the participants' dwellings, to remind them more clearly of their experiences in their space. Interviews were audio-recorded and professionally transcribed, and then cross-checked by the researcher while listening to the original recordings. Observation of residents was conducted to witness the interaction between the user and physical environments. The researcher stayed for seven-eight hours in the residents' house during the daytime on a typical day. During the observation, unstructured interviews were conducted to clarify their behaviours, which is common

and effective in ethnographical studies^[28]. Information collected included residents' behaviours, postures, use of space and the time when any of them changed.

For this study, data on the personal solitary activities of the residents was analysed. The data from observation was analysed to clarify the types of micro space used for leisure activities focusing on the furniture used. The duration of time that participants spent in each space was calculated to analyse the patterns of usage of spaces for personal leisure activities. Data from semi-structured interviews and observation were coded manually, using a coding scheme typically used in Interpretative Phenomenological Analysis^[27]. After reading and rereading the interview transcript and observation notes, explanatory comments were noted, and then emergent themes for residents' perceptions were produced. This information was coded by emergent themes. Finally, the patterns and connections between the emergent themes were identified to emerge the super-ordinate themes.

3. Findings

3.1 Participants Basic Information

Participants' basic information is listed in Table 1. Of the 30 residents, 13 were male and 17 were female. The majority (n=19) were aged between 80 and 89, and the remainder were either in their 70s (n=6) or 90s (n=5). The participants' ethnicity was largely European and/or New Zealand, but included one Middle Eastern and one Asian individual. Most participants were living alone, while three were living with their partner. The most common condition was pain or arthritis, which was experienced by half of the residents, followed by cardiac conditions and diabetes/high blood pressure (n=8). Five residents had experienced a stroke. Urinary/bowel conditions, injuries by recent falls and sight impairments were mentioned by four residents. Two thirds of the residents used mobility aids indoors. Of those who used an aid, the most common type of aid was a walker frame or a trolley (n=16), a walking stick and a wheelchair were also used by two residents.

Table 1. Basic information of residents (the numbers in italics show the number of residents)

Gender		Age group		Ethnicity		Living arrangements	
Male	13	70-79	6	European/NZ	28	Alone	27
Female	17	80-89	19	Middle Eastern	1	With partner	3
		90-99	5	Asian	1		
Conditions/impairments stated*				Type of mobility aids used indoors			
Had stroke(s)		5		No aid		10	
Parkinson's		2		Walking stick		2	
Other neurological conditions		2		Walker frame/ trolley		16	
Musculoskeletal conditions		1		Wheelchair		2	
Cardiac conditions		8					
Pulmonary conditions		3					
Diabetes/high blood pressure		8					
Urinary/bowel conditions		4					
Spinal conditions		2					
Injuries by recent fall(s)		4					
Other pain, arthritis		15					
Sight impairments		4					
Other		9					
No specific conditions		2					

Note:

*Participants were allowed to state more than one conditions.

3.2 Patterns of the Use of Space

Through the analysis of the space used for the leisure activities and the time spent, patterns in space used for activities is clarified and summarized in Figure 1. All required space that allowed an easy posture such as sitting and lying during and between personal leisure activities. All used specific sitting space (including chairs and walker frames) to spend most of their time, except for one person

who stayed mostly in his bed and one wheelchair user.

Five types of space were identified as those most used. These were spaces occupied by; armchairs, dining room chairs at a table, sofas, beds and wheelchairs. Spaces occupied by armchairs were the most common. The number of used spaces in any one dwelling varied from one to six. The use of two spaces was most common (n=16), followed by those only using one space (n=5).

The most used space	Other spaces used	(number of cases)
Armchair	(None)	(5)
	+ Chair	(8)
	+ PC desk/table for hobby + chair	(3)
	+ Dining table + chair	(1)
	+ Chair + Chair	(1)
	+ Dining table + chair + PC desk + chair	(1)
	+ Chair + Desk + chair	(1)
	+ Chair + Dining table + chair	(1)
	+ Chair + Dining table + chair + Exercise machine	(1)
	+ PC desk + Table for hobby + chair + Table for hobby + chair + Dining table + chair	(1)
Dining table + chair	+ Chair + Chair + Chair + Chair + Exercise machine	(1)
	+ Chair + PC desk + chair + Bed + Chair	(1)
Sofa	+ PC desk + chair	(1)
	+ Dining table + chair	(1)
Bed	+ PC desk + chair	(1)
Open space	+ Special table for hobby + Dining table	(1)

Figure 1. Patterns of spatial usage for personal leisure activities

Note:
The spaces shown in boxes in a row represent different spaces in each dwelling.

3.3 Perceptions Regarding the Use of Space

The qualitative analysis found six key themes for residents' perceptions that related to the use of space, which included; comfort in posture, access to sunshine and warmth, and facilitating activities to occupy residents, views to outside, control for doing everything from one space, and keeping active. In this section, four participant identifiers, PU, PR, RVI and RVS, are used to signify the housing types of public-sector rental housing units (PU), private-sector rental housing for the elderly (PR), retirement-village independent-living units (RVI), and retirement-village supported-living units (RVS).

3.3.1 Comfort in Posture

Sitting space was important for residents' rest: *'If I exert myself I've gotta come and sit down for a while, get my breath back'* (RVI3). An armchair was the most common type of chair, which could allow an easy, relaxed posture (PU5, PR1, PR5, RVI1, RVI2). One resident said, *'because, I don't know where else to sit ... I can't sit up on the [normal] chair right now, I can't sit on that thing, because I can't get up properly'* (PR5). The armrest was an important feature for many residents because it provided a support when they stood up (RVS3). Many armchairs could adjust back and feet positions. Raising the feet position was important for some (PU3, PR1, PR5, RVI4); one participant said, *'I've been told that, you know, because diabetics' ... ankles are inclined to swell ... the more I can keep my legs elevated, the better I'm off'* (PU3). An adjustable chair also facilitated having a sleep in the early afternoon, which was a common routine for some (PU5, PR7, RVI8, RVS2). A resident wanted an electronically adjustable armchair instead of her armchair that was manually adjustable with a lever handle, *'because the lever handle is too hard for my shoulder'* (RVS4).

While most elderly people used an armchair, one resident used another type of chair due to special requirements for his sitting posture. One resident used a side chair at a desk rather than an armchair like most residents used, because, he said, *'I have to sit up straight, I can't slouch. ... With the vertebrae, if I bend over like that, then those two are touching and that can cause pain, so I'm better sitting straight up so the weight is evenly distributed'* (PU4).

3.3.2 Access to Sunshine and Warmth

Accessibility to sun from the north significantly affected residents' satisfaction and their choice of the space they stayed in. One bedsit resident was fond of her sitting space with a north-facing window, because it got the sun. When

she was offered to move to a newer and bigger apartment, she declined because of her attachment to the sunshine that came into her room: *'They said "you're a silly bugger." I said, "I know I am," but I like it here, I've got the sun, and I'm happy here. I'm happy here'* (PU5). On the other hand, others were not satisfied with their access to the sun, especially those who did not have a north-facing window (PR1, RVI3, RVS3, RVS4). One resident said, *'I've got nothing facing north here, and it annoys me like mad'* (RVI11). He moved his sitting spaces *'trying to find the sun all the time.'* In the morning, he sat in a chair in the garage, looking out to the east; around noon he sat out in the deck where the sun shone from above; in the afternoon, he sat in the lounge with west-facing windows (Figure 2).

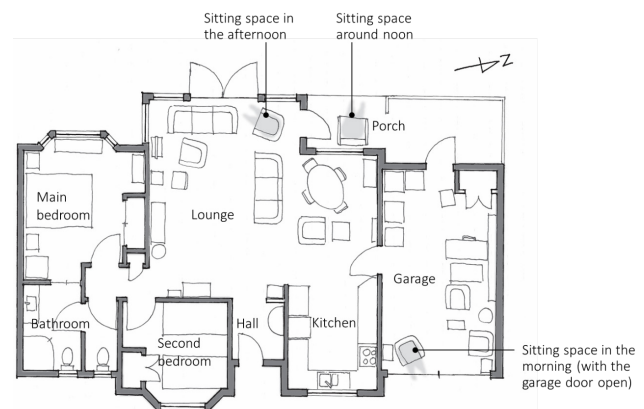


Figure 2. Changing sitting spaces according to the sun movement

In an apartment block with units on the north and south, residents on the southern side envied the northern side: *'I would like more sunshine. That's [the units on the northern side] the sunny side of the building'* (RVS3). She and her next-door neighbour often sat in the communal lounge facing the north (RVS3, RVS4), and said *'I was freezing cold. ... This is warmer'* (RVS3). Another participant who didn't have a north-facing window in his lounge mainly stayed in his north-facing bedroom, saying, *'It sounds silly to spend most of your time in the bedroom. ... It would be nicer, I suppose, if you sat out in the lounge and you got more sun'* (RVI1). Apartment residents who had east-facing windows wished for more sunshine (RVS1, RVS2). One resident said,

It comes up early in the morning over the back of these, over these houses. Usually, it comes up over that highest point in the morning and then it makes its way over, and it's off of the terrace by about 2 o'clock - almost one or two. And then it goes over the house and it shines on that side for a little while, but on the whole, that's quite a cold

side. Often people are saying, “Wish we had a bit more sun here”. (RVS2)

All-day sunshine was particularly pleasing. A first-floor-apartment resident could sit by the window without a concern about being watched. He enjoyed the sun all day through the north-facing window, and said, ‘It [the sun] comes in here from sunrise to almost sunset. It’s very warm in here’ (RVS6).

Residents used various appliances for indoor heating such as an electric heater (PR4), an oil heater (PU6, PR3), a heat pump (PU3, RVI3, RVI4) and underfloor heating (RVS2, RVS3, RVS4). In one damp bathroom, the resident installed in a towel heater (PR5). Where a heat pump was used, residents arranged their sitting space near the heat pump mounted on the low part (RVI3, RVI7, RVI10). However, one resident was dissatisfied with her heat pump, which had been installed on the high part of the wall and didn’t efficiently warm up her sitting space (RVI10). She would have preferred a heat pump on the floor.

Another resident had an infrared heater on the ceiling just above her sitting space, which she found ‘too hot’ (RVS1). In contrast, residents in serviced apartments who had underfloor heating were satisfied (RVS2, RVS3, RVS4). The cost for underfloor heating was included in the housing cost in serviced apartments, but residents of other housing types had a concern about the cost (PU1, RVI3). One resident said, ‘Some of them [other units] have got underfloor heating but what they didn’t know was ... their power bill in the winter would go up to \$600 a month. They’re very expensive’ (PU1). One couple didn’t use their underfloor heating because it was ‘far too expensive’ (RVI3).

3.3.3 Control for Activities to Occupy Residents

Some high-needs elderly expressed their boredom due to a limitation in activities. However, others succeeded in being engaged in private activities in their own dwellings. One resident said, ‘I’ve got plenty to keep me occupied during the day... Oh I’m busy enough, you know. I’m not bored, put it that way. I love life, I love life’ (PU3).

Watching TV was the most common activity, and most seating was laid out in respect to the location and direction of the TV. In a small lounge, residents wanted to put the TV on the wall (PU5, RVS3). There were differences in preference and duration of this activity. A man who had very limited mobility watched TV all day, saying, ‘That would be the only thing, I’d go nuts without the television. Gives me something to do’ (PU1).

All sitting spaces or beds were laid out in respect to the location and direction of their TV, except for one person

who did not like watching TV (RVI8). A participant with limited eyesight put his chair close to the TV (RVI11). Those who had sight impairments prefer to sit with their backs to the windows (PR4, RV7). One resident said, ‘I don’t think I could cope with that [the opposite layout]. Because you’re looking into the light all the time’ (PR4) (Figure 3). Residents had remote controls to turn on and change channels as well as adjust the screen brightness, and kept a program guide within their reach.

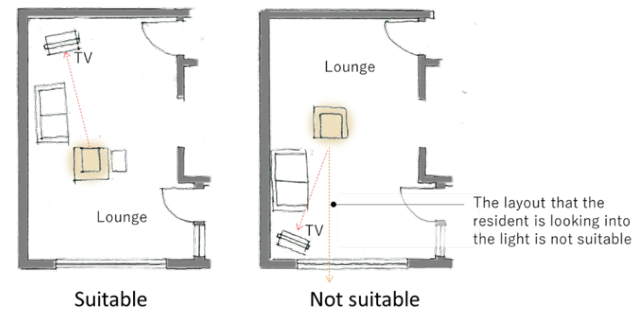


Figure 3. Layout of a chair and a TV for people with vision impairment

Reading was often an important activity during sitting for many residents. Reading a newspaper was problematic as the size of the newspaper was too large to easily manage. A woman with Parkinson’s said, ‘It’s difficult to handle them without a table. It’s too big’ (RVS1). Necessary tools and Writing was also a preferred reach of their sitting space, such as eyeglasses, a magnifier, a letter opener, a lamp, a level surface to put books on, and bookshelves.

Writing was also a preferred activity. Some often wrote letters or postcards (PR3, PR7, RVI6, RVI7, RVS3). Some wrote about their life (PR2, RVI6); one resident said, ‘I do quite a bit of writing still. Now I just do diaries and things for my family really. ... A lot of questions [from her family]. And still writing the answers to her questions in this book’ (PR2). A man whose wife had dementia and lived in a hospital said, ‘I usually start writing two diaries. There’s a diary for me as to what my activities have been during the day, and the other one is a diary about how I have found [my wife]’ (RVS6). A dining table or a writing desk were often used for handwriting, and a PC table for writing with a computer.

Some people liked to listen to music, with CDs (PU1, PU2, PR2, RVI11, RVS1) and vinyl records (PU3), and some liked listening to the radio (PR2, RVI11, RVS4). A man with limited eyesight talked about the benefits of listening to music: ‘I just like, sort of, listening to it. It passes, time goes quickly, and it helps get you relaxed, and feel all right’ (RVI11). He also liked listening to audiobooks

that he subscribed to, saying, 'I read a lot, I read, I listen to talking books. I have a lot of magazines and a lot of books' (RV11). Another man who had also issues with eyesight used read-to-speech software to read the contents on the computer (PU4).

Crosswords were a common activity while sitting (PU2, PU5, RVS2, RVS3). Some people played games on a computer (PU2, PU3, PR1) or a tablet (PU5). A man explained the benefit of PC games: 'It keeps your brain ticking over, that's what it's all about, you know' (PU3). He played them sitting in his armchair, putting his laptop on the armrest, while a resident with hemiplegia needed to sit at a table to support his left arm (PU1) (Figure 4).



Figure 4. Posture of the resident with hemiplegia when sitting at the table

Having a cup of tea and eating meals often took place in this space. Many people used their knees, and adjacent level surfaces such as a side table, a portable table, a kitchen bench or their trolley were used for dining.

3.3.4 Views to Outside

Many people liked seeing outside, which was often the main reason for the choice of the positioning of their sitting space, though some people had little concern about other people's movements outside (PR3, RV13). Seeing moving things such as people and cars was preferred. A resident said, 'You can see out and see what's going on ... Reminds me I'm still alive' (RV12). An elderly couple looking outside and subsequently arranged from each other regarding looking outside and subsequently arranged their armchairs differently (RV13) (Figure 5).

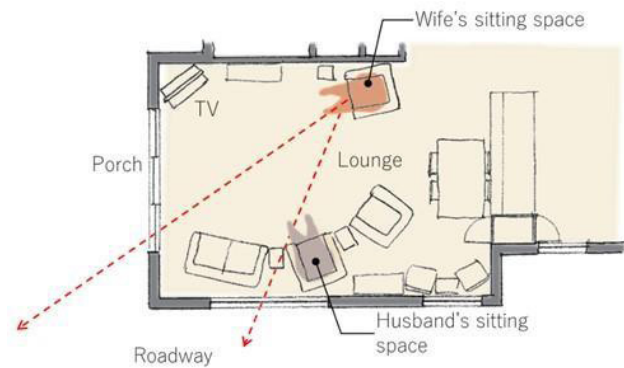


Figure 5. Difference in the sitting position depending on the preference for seeing outside

3.3.5 Control for Doing Everything from One Space

Some residents engaged in multiple activities and tasks, which could be fostered by the organisation of furnishings surrounding their sitting space. One resident sat at his chair facing his PC screen as well as his TV screen. While watching TV, the PC screen notified him of the arrival of messages from friends, at which point he walked to the PC and read the messages (PU4) (Figure 6 left). Another resident with a limited mobility could reach the mouse as well as see his PC screen, which allowed him to view emails from his armchair. He said, 'Yeah, I have to do everything, eat and everything here, from here and, um, do my computer over there' (PU1) (Figure 6 right). Another man said, 'I can do two things at once. The ear's that way [to the TV] but mostly the eyes are looking this way [to his laptop]' (PU3). He liked horse racing, which required him to watch TV, take notes on paper, and place bets through the computer that he rested on the armrest of his armchair (Figure 7). He said, 'I've got everything at my fingertips here'.

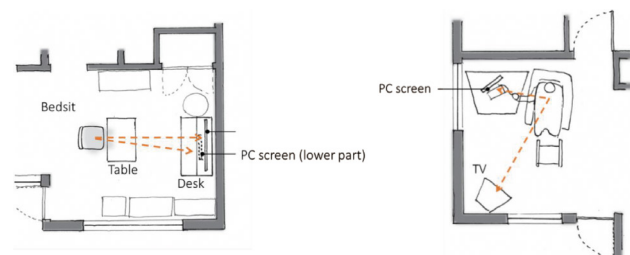


Figure 6. Layout of the PC screen that can be viewed from the sitting space

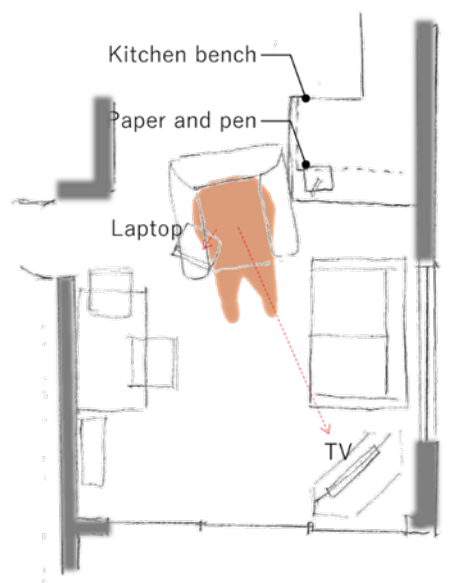


Figure 7. Sitting space that facilitated engagement in multiple activities

Various tools for activities and the furniture and fixtures to accommodate them were placed within reach of residents' sitting space. Level surfaces such as shelves or cupboards with multiple drawers were particularly useful for keeping things tidy (PU3, PR1). A woman who was good at needlework made a handmade organizer for two remote controllers and stationary (scissors, a letter opener, two pens) that could be hung on the armrest of the armchair (RVS2) (Figure 8). Where there were not enough level surfaces, residents placed objects on an adjacent table or desk and put things on the floor (PU1, PU5, RVS3).



Figure 8. Hand-made storage for remote controls, pens and so on

3.3.6 Keeping Active

Some residents did exercises on their own. Two men had exercise bikes at their unit and used them often. A post-stroke elderly man used his exercise bike quite regularly: “[I do exercise] at least once a day. ... Because I’m trying to get this leg okay, you know. (PR2)”. The exercise bike was also used as an alternative for going out for a walk: “I’m too light-headed, and I’m likely to have an angina attack or something, so when I can’t walk outside or if it’s too wet, I get on my exercycle” (RVI11). One man performed an exercise of raising his knees while sitting in his armchair: ‘I do this. ... two, three, four, five, six, seven, eight, nine, ten. That’s it. ... “Knees up Mother Brown” (RVI4). Another participant performed his routine exercises, moving his legs, ankles and hip lying on the bed (PU6). One lady who has arthritis in her hands did knitting to help her hands: ‘I used to knit years ago. I’m starting up now to keep my hands, um, arthritis and that. If you don’t work, you get all crippled, so I knit’ (PU5). A man who had impairments following a stroke kept a ball on the side table by his armchair. He said, “My left arm ... That’s why I have a ball [for exercise] there” (RVI8).

Some residents preferred to avoid a completely sedentary lifestyle. A male resident spent most of his time in an armchair in his bedroom, except for when he watched TV in the lounge. When asked whether he would like to have the TV in the bedroom, he said,

“Oh yeah, it’d be quite nice... No, if I had the TV in here I would spend too much time sitting or lying down. I think having it in the lounge keeps me active... No, if it was in here I’d be lying on the bed for hours... In one sense it’d be nice, but it wouldn’t do me any good. (RVI11)”

One caregiver suggested the significance of space for moving around;

You have to have a small patio kind of area from their living room area they can go out on when it’s a sunny day, where they can sit down and stay. So that will make them kind of move... They have to move around. (PR5)

Some activities required a separate space with special furniture, such as a writing table, a PC desk or a table for handcrafts and needlework. One female resident who lived in a two-bedroom house had different spaces for different activities (Figure 9). She liked reading in an armchair by the window, with the sunlight falling on the book. She also had a card table where she liked to do jigsaw puzzles, which were kept on the table even if uncompleted. She operated her computer at her PC table, and she wrote at the writing desk in her bedroom, which she really liked because it was “very private” (RVI9).

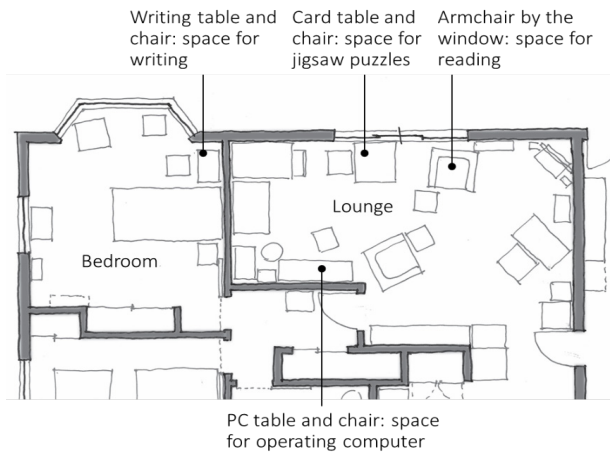


Figure 9. Using different spaces for various activities

4. Discussion

Facilitating individual meaningful activities for elderly people living in private dwellings is a research area which has been receiving attention^[10,19,20], yet there is only limited information with regard to the necessary spatial design requirements. Using an ethnographic approach, this research has delved into personal activities of those with care needs and provided insights into optimal housing design for them. In particular, it has provided clarity regarding essential considerations for the micro space of the high-needs elderly described by Hale et al. such as “placing necessary items conveniently to hand, on small tables on either side of the individual’s chair, to ensure as little movement as possible”^[24].

Providing multiple spaces for activities widens the range of activities that can be enjoyed by residents. However, this research highlighted the significance of the design of the single sitting space which the residents used most of their time. Careful consideration should be given to the micro-environment surrounding this space as most leisure activities occur in this space, such as reading, knitting, doing sitting exercises, talking on the telephone, doing crosswords, cutting fabrics or paper, writing letters and using the computer. An armchair is most commonly used as it allows for comfortable posture and the armrests help with getting up and sitting down. Adjustable reclining armchairs are appreciated by participants who needed to lift their legs to ease discomfort, which has implications for the areas both to the front and rear of the chair.

The spatial organisation should allow for a layout which can accommodate an adjustable armchair with room for adjacent level surfaces or storage to ensure necessary things are within reach, enhancing residents’ control of their environment and facilitating activities.

The adjacent level surfaces and storage areas can include shelves, tables, desks, kitchen benches, drawers and trolleys that can accommodate various items such as a telephone/handset, remote controls, glasses, medicine, cups of tea, pens and paper. Additional lighting should be provided for this space, where residents often enjoy reading. Additional power outlets, ideally located at sitting height and within reach are needed to accommodate a range of technologies and charging devices.

As watching TV was the most common activity, room layout should consider the location and proximity of the TV in relation to potential armchair locations (including the option of hanging the TV on the wall) and the windows. The layout of a TV in front of a window, which compels residents to stare at the window, should be avoided for those with eye impairments. Similarly, window glare on the screen should be avoided. Given that some elderly people like to view their computer screen to detect the arrival of new messages or updates on social media websites, similar attention should be given to views of a computer screen as well.

Attention should be given to the layout of doors and windows so that residents can enjoy the views of people and vehicles moving outside but at the same time maintain privacy. The use of sheer or lace curtains, which can both let sunlight in and block views into rooms; can block views to the outside and are not ideal for unobscured views. These can also be difficult to close and open. Using vertical blinds that can be angled is a better solution for blocking views from the outside in, while allowing views from the inside to the outside. Other strategies should also be considered to facilitate the connection with the outdoors without losing privacy, such as limiting the window height (e.g. avoiding full-height windows) and providing a level difference between inside and out, or ensuring that there is adequate distance between the unit and any communal pathways.

Warmth is essential in the sitting space; however, the use of solar warmth relates to windows and as such can present special challenges. In Southern hemisphere countries such as New Zealand, the space should ideally have north-facing windows for passive solar gains and to provide a warm sunny well-lit space. However, in the evening this same window can result in radiant heat loss unless strategies such as double glazing and/or thermal curtains are employed. Windows directly facing south in the Southern hemisphere can be detrimental to residents as they contribute to radiant heat loss, while offering little in the way of natural light. Study participants in east-facing units also felt cold. A heat supply should be provided in proximity to the sitting space, and suited to warming

lower areas where drafts are more prevalent. Underfloor heating or a heat pump mounted on the low part of the wall can address this concern. Overhead positioning of heat pumps or infrared radiant heating on the ceiling is often uncomfortable, so should be avoided. Finally, considering that doors are often kept open between the lounge and adjacent rooms, the heating capacity of any heating device should take this into consideration.

While the design of the space where the elderly spend most of their time has a significant impact on their control and enjoyment of activities in a comfortable manner, the interior layout of housing also has implications for maintaining an active lifestyle and facilitating a wider variety of possible activities. Occupying larger housing with more rooms is not always a better solution. In order to evaluate a suitable size, attention should also be given to the ease of upkeep as many elderly people experience difficulty in keeping up maintenance of their housing^[6,7,8].

The use of space and perceptions of elderly residents can provide architects and designers with new insights to form the basis of improved housing design. Designing around a reclining armchair or a pair of reclining armchairs can shed much light on the challenges of designing for this cohort. This research will be benefited by combining it with insights with regard to other activities occurring at home, such as social activities and interactions with caregivers, to provide more holistic design considerations.

Future research is needed to focus on differences between sub-groups such as by types of impairments and conditions, or types of mobility aids used, as this research has identified different requirements for those with specific conditions/ mobility aids. For example, the suitable type of chair was different for people with spinal conditions, some of whom preferred a side chair to an armchair, and for post-stroke patients with hemiplegia who required space that could provide extra support for their impaired side. Special attention was also required for the layout of the chair with respect to windows for those with sight impairments. Suitable space was also unique for wheelchair users, who only required open space. Given that the preference in activities can also differ by ethnicities^[29], research with various ethnic groups can inform the design that is most suited to facilitate preferred activities of each group.

5. Conclusion

This paper clarified the spatial considerations for private space to accommodate personal leisure activities of the high-needs elderly, through an ethnographical investigation of 30 elderly participants with care needs. It first

examined the typical use of space for leisure activities and perceptions of it. Then, it clarified the types of micro space focusing on the furniture used, and examined the patterns of the spatial use. The five most commonly used spaces were those that accommodated; a reclining armchair, a dining table + chair, a sofa, a bed and open space. Next, a qualitative analysis was conducted from the interviews to distil themes for the residents' perceptions with regard to the spatial use, which included; comfort in posture, access to sunshine and warmth, facilitating activities to occupy residents, views to outside, control for doing everything from one space, and keeping active.

The research finds that most participants had a space where they sat for long periods of time, which became increasingly important as mobility declined. Careful consideration for the layout of the micro-environment surrounding the sitting space where residents spend most of their time is necessary to maintain quality of life. The main object requiring careful design consideration is that of the reclining armchair which consumes quite a large amount of space when in its reclining position. Design should focus on serving this space and permit the layout of furniture for sitting and lying with adjacent level surfaces and sufficient sources of power to ensure things are within reach, thereby facilitating greater control and access to activities. Types of sitting space should also take account of differing spatial requirements for type of impairments and mobility aids used. Sunshine, warmth, views, and privacy are also important factors for the design of this space but often present contradictory conditions which must be addressed. The interior layout has implications for maintaining an active lifestyle as well as facilitating the variety of activities that occur in the house. Designs should be tested against these requirements using furnishings to ensure comfort and lifestyle are not compromised. Thoughtful housing design can help residents continue their fulfilled life in their own home even after care needs arise.

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