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1. Background

Ageing populations are now a global phenomenon with statistics predicting the number of people aged over 60 to reach 1.2 billion by 2025 (WHO, 2007). A number of issues may arise as a result of ageing, this may include: physical (reduction mobility and strength); sensory (sight and hearing loss) and cognitive decline (Brawley, 1997; Burton and Mitchell, 2006). Dementia is not considered to be part of the normal healthy ageing process, although the risk does increase with age (Alzheimer's Society, 2014). Memory loss is perhaps the most known symptom linked to dementia, however other symptoms include: the depletion of language and communication skills; personality and behavioural changes; issues relating to executive function; time and spatial orientation; and visuo-spatial problems.

Visuo-spatial perception and spatial orientation problems result in persistent wayfinding difficulty and this begins even in the earliest stages of the disease (Passini et al., 2000; Daykin et al., 2008). This can have a debilitating effect on the person with dementia, causing agitation and reducing their independence. Perception can also be affected by the type of dementia depending on which parts of the brain it affects. Coupled with sensory or physical impairments, this can cause greater issues with the wayfinding experience. Long term care settings are larger, more complex environments in terms of wayfinding as compared to the person's own familiar, domestic scale home. With reference to the design of dementia specific long term care settings, Passini et al (1998) explain that if cognitive mapping is reduced, then the spatial organisation and environmental communication become increasingly important. Lynch (1960) describes the consequences of getting lost:

> "To become completely lost is perhaps [...] rare [...] But let the mishap of disorientation once occur, and the sense of anxiety and even terror that accompanies it reveals [...] how closely it is linked [...] to wellbeing [...] it carries overtones of utter disaster [...] A good environmental image...is the obverse of the fear that comes with disorientation [...] Indeed, a distinctive and legible environment not only offers security but heightens the potential depth and intensity of human experience" (Lynch, 1960, pp.4-5)

Marquardt (2011) identified that few studies had examined the effect of the architectural floor plan of long term care settings on wayfinding success for people with dementia. Research relating to this is recent with Netten (1989) who was the first to consider spatial layout in terms of wayfinding for residents of dementia care homes. Netten's work relied on staff to assess which routes residents could find independently and those where they required assistance. Similarly Elmståhl et al. (1997) asked staff to assess confusion and disorientation behaviour using the Organic Brain Scale and evaluate the design (space, lighting, noise and floor plan) using the Therapeutic Environmental Screening Scale. Additionally they categorised floor plan shapes into typologies. This has significance to wayfinding as the architectural floor plan is influential on determining which routes can be travelled in the building.

Methods used by Passini et al. (1998; 2000) and Mitchell et al. (2003) were influential on this study as the research design allowed for meaningful participation with the person with dementia. These landmark studies used observational methods to record first hand interactions of people with dementia in the physical environment. While Mitchell et al.'s work was concerned with urban design and wayfinding, Passini et al. had conducted their observations in single sites (a hospital in 1998 and a nursing home in 2000). More recently Marquardt and Schmieg (2009) used similar methods to Netten (1989) and Elmståhl et al. (1997) where 450 residents' wayfinding ability in 30 different nursing homes was rated by nursing staff.

The dearth of research justified the need for further research. Enabling participation for the people with dementia was determined to be vital in recording real experiences and perspectives, therefore observational methods similar to Passini et al. (1998; 2000) and Mitchell et al. (2003) were adopted.

2. Methodology

This paper focuses on the findings from the observed wayfinding walks with people with dementia living in long term care settings. These were conducted as part of a PhD study and were intended to enable meaningful participation in the research for the people with dementia. This would explore their wayfinding experience in the long term care setting and elicit their perspectives.

2.1 Fieldwork sites

The context of this study is based in Northern Ireland where there are a larger number of long term care settings per capita than elsewhere in the United Kingdom (Bell, 2010). Four fieldwork sites were selected as case studies to provide a range of design plan typologies and shapes. Hadjri et al. (2011) identified that there are 44 residential and 75 nursing homes in Northern Ireland. Fieldwork sites were chosen to be representational of the existing stock of nursing and residential homes. It was also important to include multiple fieldwork sites to allow for different route types and complexity in the wayfinding tasks. Common architectural floor plans for long term care settings were identified and included Y, H, linear and circuit type plans as case study sites (Figure 1).

The four homes were selected to provide a variety in the architectural plan typology and design. The Y-shape plan enabled more complex routes to be explored with two or more major decision or anchor points. Additionally the ground floor plan of the Y-shape plan had a separate unit which produced a linear type route. The H-shape plan was similar to the Y-shape in terms of complexity, providing routes with a number of changes in direction. The linear type plan had the fewest changes in direction and determined routes were largely linear. The circuit or figure of eight plan incorporated corners and required a level of decision making to select the correct route. Fieldwork sites two (F2) and fieldwork sites five (F5) are classed as residential homes, whereas fieldwork sites three and four (F4) are nursing care homes.

2.2 Measures for observing the wayfinding walks

To determine the average walking speed, each participant completed a 10 m walk in a straight line. This was then referred to throughout the analysis of the data to establish patterns or fluctuation in walking speed. This allowed for the data to be normalised and compared across other participants.

Behavioural mapping was used to record the details of the walks. A combination of qualitative and quantitative data was collected and included: distance, time, speed between points (relating to the points marked on the architectural floor plan), conversation, observed behaviour and the image from the lanyard camera (worn by both the participant and researcher for the duration of the walk to identify what environmental features are viewed). The participants of the wayfinding walks were debriefed using conversational style semi-structured interviews to elicit their views and opinions regarding the design of the home.

The compact video recorder was carried by the researcher and was used to record the behaviour and conversation for the duration of the walk. This assisted with behavioural mapping and transcribing the information from the walk. The development of the research design was influenced and refined through the consideration of ethical issues and by trialling and piloting to overcome any other technological, practical and data collection and analysis issues. Ethical approval was obtained from the School's Research Ethics Committee (SREC) and from the Office of Research Ethics Committee, Northern Ireland (ORECNI). Data from the cameras and video were immediately transferred to a computer on the university campus which was password encrypted. Once data had been transcribed from the video cameras the recordings were erased. Confidentiality and anonymity was ensured by pixelating images which had people in them and by using codes to protect identity. For instance F1_P3_W2 would refer to fieldwork site one, participant three and denote walk two.

2.3 Participant selection

Participants were recruited through staff who identified suitable candidates to take part in the wayfinding tasks. This was defined a priori by the researcher who developed the following inclusion criteria:

- Residents should have lived in the home for a minimum of three months.
- Potential participants shall have the capacity to provide ongoing informed consent.
- They shall have the physical ability to complete a short walk (may use walking aids).
- Age and gender: there is no preference, however they are likely to be older adults.
- The mini mental state examination (MMSE) score should be taken into account. This will be recorded as part of the demographics and considered in terms of stage of disease during the analysis of results. Those with early-middle stages of the disease may be more likely to be suitable candidates.

The stage of dementia was considered and generally most participants were in the early or middle stages of dementia. MMSE was used to help to determine which stage the person was at, but since it is a one-off short 30 point questionnaire it has been subject to criticism and is not considered to be definitive (Folstein and Folstein, 1975; Friedl et al. , 1996).

The nature of the disease means that cognitive ability can fluctuate, this reinforced the role of involving staff in the selection process. Exclusion criteria included those who lacked the capacity to understand the task and give informed consent, and those who were physically unable to complete the walks. As a result, a total of 14 participants were recruited across the four fieldwork sites. For a summary of the fieldwork conducted, see Table 1.

Recruitment of participants in fieldwork site four (F4) proved to be difficult as many of the residents in the home had poor mobility and or were unable to understand the task and give informed consent. The result of this meant that only one participant was recruited. Ideally the number of participants in F4 should have been similar to the other fieldwork sites. However linear routes existed in F2 and F5 due to the zoning of a unit and the selection of a route respectively.

2.4 Procedure

A repeated measures design was adopted to examine the effect wayfinding ability over a period of time. Three walks were conducted; walk one (W1) was led by the researcher and the person with dementia led walks two and three (W2 and W3). W2 was completed on the same day following a break from W1 and W3 was conducted one week later. On W1 the researcher would explain the purpose of the walk and state that they will lead the way and the participant will accompany them. The concept of repeating the tasks was to provide a within subjects control and determine whether there was any evidence of route learning. W1 was intended to demonstrate the optimal route and provide the opportunity for learning. It was posited that ability shown on W2 may indicate short term memory retention. If there was improvement on W3 this may show the ability to retain the information on a longer term basis. It was recognised as important by the researchers to consider the effect dementia may have on this.

The selected routes had an origin and destination and were based on which parts of the building the participants had access to. Another consideration was using terms the participants were familiar with and knew the locations by, for instance living room as opposed to parlour or lounge. Verbal instructions to the participant were given at the start of W2 and W3. An example of an instruction would be “Please take me to the dining room.” Conversation throughout was also recorded and this was analysed for prompts or potential distractions. All walks used the same routes throughout so the participants had previously experienced the starting points and destinations. Both outbound and return journeys of the walks were recorded to check for patterns in both directions as the spatial experience and perspective changes in the different direction, despite sharing the same physical properties of dimension and distance.

3. Results: performance across the three walks

Before identifying features of the physical environment which enhance or hinder wayfinding, the patterns of the three walks will firstly be discussed. The performance of the participants was examined to identify if there was any indication of improvement or deterioration across the three walks.

3.1 General findings from the three walks

Results from the four different fieldwork sites indicate reduced wayfinding performance after W1. Generally there appears to be a progressive reduced ability shown as the number of walks increases, where W2 is worse than W1 and W3 is worse than W2. This is classified in terms of distance travelled, time taken, average speed and number of pauses or prompts due to getting lost behaviour (see Table 2). Figure 2 represents a typical graphic representation of reduced performance across the walks. In F2 and F5 which are categorised as residential homes (as opposed to nursing care homes: F3 and F4) there appears to be a greater capacity to retain memory and learn from previous walks, so the performance on W3 may not be greatly reduced. However W3 which is conducted one week later than W1 and W2 tends to be the poorest performance with speeds that are usually below average. It was determined that W1 was the most efficient as it usually recorded the shortest distance and fastest time. This is supported by the increase in pausing behaviour and the number of prompts required. This increases as the walks go on, from W1 to W2 to W3. Pausing and prompts are required at major junction points, for instance the central area in F2 and F5 and the T-junctions in F3. Consequently the average speed decreases across the walks, with the speed on W3 often reduced below the average (obtained from the action capability test). Despite only being able to recruit one participant in F4, similar patterns emerged to that of the other homes and the straight line walking route was comparable to walks which occurred in F2 and F5.

Demographics were used to contextualise the participant and highlight issues that may affect the individual's wayfinding performance. This may include the type of dementia, sensory impairments or any relevant medical problems, for instance Chronic Obstructive Pulmonary Disease (COPD). The walking speeds were also compared to the action capability test walking speed to determine whether speeds were above or below average.

3.2 Anomalies and possible explanations

Irregularities occurred when there was an improved performance on W2 from W1. This was the case for four of the participants (F3_P1_W2, F3_P2_W2, F3_P3_W2 and F5_P5_W2). This was not expected by the researchers and may suggest that they had the ability to retain short term memory (showing evidence of learning) and focus on the task. For these there is an initial increase in speed, followed by a plateau of speeds above average after this. From examining Table 2 F3_P1's improved performance on W2 is due to the shorter distance travelled and they experienced a similar performance on W3 as they did on W1. F3_P2 and F3_P3 on the other hand had their poorest performance on W3. F5_P5 only completed W1 and W2 so it is not possible to say how whether they would have improved or not on W3.

Separate to those who showed improvement on their second walk, two other participants performed better during their third walk (F2_P1_W3 and F5_P1_W3). The improved performance of F5_P1_W3 can be seen in Figure 3. Table 2 also shows that F2_P1 and F5_P1's performance on W3 was comparable to W1 with similar distances, times and average speeds recorded. However for F5_P1 they had a reduction the number of prompts and pauses on the third walk (four compared to five on W1 and W2). These types of anomalies may be caused from exertion they experienced on W2 (conducted on same day as W1) as they had COPD (a medical condition which can adversely affect their mobility). In both cases for F2_P1 and F5_P1, the demographics in Table 2 show that their MMSE scores indicate that they are in the earlier stages of dementia which may reflect their ability to maintain a steadier performance on W3.

3.3 The need to examine environmental features

The patterns of the three walks in the four different fieldwork sites reveals how dementia inhibits the ability to retain knowledge of routes, impairing wayfinding performance during W2 and W3. While this information on performance across the walks is important, it is necessary to synthesise findings by delving deeper into the information from the observed walks and behavioural maps (including the lanyard camera images, conversation, distance, time, speed and route travelled). It is therefore necessary to examine the data from the walks to identify which specific features of the physical environment affect wayfinding ability.

4. Findings from the wayfinding walks

Analysis

A variety of data was collected as part of the observed wayfinding tasks. This was collated onto data sheets to allow for cross referencing and comparison. The route was drawn onto the architectural floor plan along with the observed behaviour in the space relating to the transcript. Patterns of cause and effect were drawn in cases where the physical environment was supportive or caused issues with wayfinding. Figure 4 shows an excerpt of a sample Microsoft Excel sheet used in the synthesis stage to examine the empirical data.

Results

The results from the wayfinding walks have been organised into four domains which cover environmental and managerial aspects which impact on wayfinding. These are defined as follows:

- **Architectural domain:** relating to the architectural floor plan and spatial configuration.
- **Interior architecture domain:** features of interior design, including finishes and furniture.
- **Personalisation domain:** this is the recognition that wayfinding is a personal experience, interpreted in different ways for different individuals using their senses.
- **Management and care domain:** a well designed environment is supportive of social care.

Although the latter two domains are not directly associated with architectural design, they are relevant in the design process or the general day-to-day care of the residents. Features that were identified as having a positive or negative impact on wayfinding for those with dementia will now be discussed and illustrated within the four domains. To assist with the comparison of the design typologies, a small icon symbolising each of the fieldwork sites will appear below the issue described if it was present in the home. Visual summaries of the wayfinding issues encountered in each of the different plan typologies can be seen in Figures 5 - 8.

Findings and Recommendations

4.1 The architectural domain

Central hub

Present in the following homes:

The central area can create a hub for monitoring. However, issues occurred when the central area was in a symmetrical plan or there were multiple choice junctions. This can create a homogenous view where areas look the same in different directions. Decision points should therefore be reduced or made distinct from one another. Table 3 illustrates issues relating to symmetry, homogeneity and the central area in F2.

The issue with T-junctions

T-junctions caused issues in theses homes:

T-junctions were the cause of residents in F3 and F5 selecting the wrong direction. This has a symmetrical effect in one direction and in the other the cue to make the turn may be missed.

Avoid long and narrow corridors

Long narrow corridors were in:

Straight sections of corridor were observed to encourage movement and increase walking speed. This can be explained as the featureless corridors lack distractions. However, this may cause residents to miss cues, particularly if they are designed in a homogenous manner where all doors to adjacent rooms look the same. Long narrow corridors are often a result of bedroom wings in long term care settings and can be confusing and daunting as compared with the smaller domestic environment.

Thresholds

In homes that had an obvious entrance/exit or a door to staff only areas, distress was witnessed when the person was not able to access to those spaces. Two residents in F3 experienced distress when they wanted to get outside. They could see the exit but their access to it was barred due to the locked door. The hierarchy of spaces within the architectural floor plan is therefore important in creating a sense of freedom of movement.

Avoid areas that appear out of bounds

Layout of these homes made areas feel out of bounds:

The effect of dead-ends, geometrical shifts or kinks in geometry in corridors and locked doors is similar to entrances/exits which are out of bounds to residents. This can cause anxiety so should be avoided where possible. This affected five residents in the three different homes.

Views within and out of the building

Good views to outside spaces along the circulation in:

Internal glazed screens and windows offer visual connections and views of areas which residents referred to, allowing them to see room or garden without going in. If the function of the room was made explicit through interior design features (see 5.2 Identity and clearly defined areas) then this assisted with wayfinding through the identification of certain areas in relation to others.

Gardens are overlooked

Good access to the garden in the courtyard:

Brawley (2006) recognises the importance of outdoor spaces for wellbeing. The right to free accessible outdoor spaces should be integrated within the design of the long term care setting. This must be considered from the inception of the design and address shelter, lighting, seating, activities and the micro-climate. Access to well designed gardens was overlooked even on larger rural sites. Upon first examination the provision of freely accessibly gardens which can be monitored may not firstly seem to be a wayfinding issue. However residents in F5 referred to the garden as a landmark or reference point throughout their walks as it was a courtyard garden, visible at various points along the walks.

4.2 Interior architecture domain

Furniture positioning in the central hub caused issue in:

 

The positioning of objects, furniture and the arrangement of seating was observed to pose as an obstacle by restricting pathways of movement. This was an issue in F2 where the central area was used as a large seating area. The layout of the chairs meant that the route for walking was restricted to the perimeter of the room. This may have impaired wayfinding as the pathway for walking had been reduced and this could cause unnecessary changes in direction. In contrast to this, placing chairs around the perimeter of the room may have a negative impact by creating the illusion of a waiting room. A caveat is placed on the positioning of objects and furniture which act as useful directional and locational wayfinding cues. However, if these a poorly placed they can pose as barriers, trip hazards and may be perceived as a clutter of information causing confusion.

Signage

Passini et al. (1998) proposed that signage should provide complementary information and should not be a primary cue that needs to be relied on for wayfinding. This suggests that the architectural design and spatial configuration is paramount in supporting wayfinding. However, with this considered signage may assist with the wayfinding experience by helping residents to correctly identify places. This was particularly relevant in F5 where local street names were used.

The most successful signs used pictograms, text and bold colours to make them easily identifiable and easier to interpret. Some residents in F5 correctly referred to their room number. In F3, one resident referred to an old address as their room number so relevant names and numbers for addresses are perhaps more appropriate. F2_P4 explained that signs were too high. Signage should be at eye level or lower to reflect the field of vision the residents will have.

Identity and clearly defined spaces

Decoration, furniture, objects, murals and artwork can provide information about what the function of an area is. This coupled with views to the space can assist with successful wayfinding and the creation of landmarks.

4.3 Personalisation domain

Wayfinding: a sensory experience

Hall (1966) explains that perception is a unique experience for individuals who inhabit different sensory worlds. Related to this is how different sensory information can trigger memory of places. This was evident on the wayfinding walks where participants displayed knowledge of places because they remember events which took place in rooms or the smell of baking or how the furniture had an antique look.

Sensitivity to an overload of sensory stimulation

High levels of noise were observed to be a distraction in terms of wayfinding. In F2 the television was watched in the main central area. This may have been a contributing factor in addition to the effect of symmetry, seating arrangement and the multiple choice junction. The home alarm in F3 was triggered during the outbound walk of W2 for P4. They missed the cue to turn right at the T-junction, continuing along the straight part of the corridor. Again the effect of becoming disorientated may have been exacerbated by the noise as they appeared anxious after this.

4.4 Management and care domain

Designing a supportive environment

The physical environment should be supportive of group and individual activities. The design and layout of the building should facilitate the care and management experience, for instance providing good visual access to areas to enable monitoring.

Establishing a routine

It is important to establish a routine to help settle residents into the home. This may help with wayfinding as they become more familiar with their environment.

Planning issues and considerations

The design of the physical environment can enhance staff and visitor experience as well as the people with dementia living there. Integration into the community was important and access to existing services, including bus routes, pharmacies, shops and primary care surgeries were discussed as important. The context of the study was in Northern Ireland and it was felt that the homes should be accessible to all and not polarised to a specific community. Although these are not directly linked to wayfinding, they are important factors to consider during the early stages of design.

5. Concluding discussion

While there are some existing design guidelines for dementia including the comprehensive Design for Dementia Audit Tool compiled by Dementia Services Development Centre (DSDC) and Stirling University (Cunningham et al., 2008), research regarding the issue of wayfinding for people with dementia living in long term care settings has been overlooked. This research paper contributes to the knowledge base by providing empirical evidence relating to architectural an interior design. Additionally it emphasises the need to consider aspects relating to the individual’s experience and the approach to care. Establishing routine and providing a supportive physical environment can improve care and the experience for staff and visitors in the home.

The spatial experience should appeal to the senses and create memorable interactions Sensory information may be important in wayfinding for older people with dementia as some participants referred to previous experiences where they recalled the smell of baking or an event such as singing or getting their dressings changed in a particular room. Burton and Mitchell (2006) state that hearing and sight may become impaired with age so it is important to consider the overall experience by including tactile, oratory, audio and visual cues.

Similarly Bennett (2006) supports this notion and places and impetus on the need to create a rich spatial experience to create a more memorable journey. Utton (2007) concurs with the Bennett (2006) but places an emphasis on providing a calm environment and reducing sensory clutter. The wayfinding walks conducted revealed this is important as noise can cause confusion and anxiety, thus reducing wayfinding ability.

Architectural design often focuses on the visual sense, so the other senses may be overlooked. Connected to this is the design features proposed by DSDC (2007) may also be received with resistance by architects and interior designers who disapprove of the aesthetics of a more enabling environment, for instance in bathrooms where a contrasting colour such as blue is used on a white bathroom suite's toilet seat and grab rails to aid visual perception. Many of the long term care settings are particularly difficult in terms of wayfinding due to the size and complexity of the plans. An environment which lacks features and adopts long narrow corridors can create a greater labyrinthine effect, creating havoc for the person trying to find their own room.

The design considerations which have been presented complement existing design guidelines and offer specific information with regards to wayfinding for dementia. Through the innovation of the designer, these may be applied to specific projects and sites to improve design for people with dementia. The research compares to the work by Passini et al. (1998; 2000), Mitchell et al. (2003) and Marquardt and Schmieg (2009) who used small sample sizes and similar methods using in-depth observations of people with dementia walking. The results from the wayfinding walks suggest that dementia impairs the ability even at the early stages. This confirms previous work conducted by Passini et al. (1998). However there appears to be some ability to retain information and perform well on the second or third walks in those who are in the earlier stages of dementia. The type of care home is also reflected in this. Those living in the residential homes generally had higher MMSE scores indicating earlier stages of dementia and performed better on the wayfinding tasks than those in the nursing homes.

Netten (1989) found that simple, compact plans which have places with obvious and distinct functions assist with wayfinding in addition to features which can act as wayfinding reference points. Items that were described by Netten (1989) as causing issue with wayfinding were long narrow corridors and repetitive elements. Passini et al. (1998; 2000) posited that because cognitive mapping abilities are reduced in people with dementia then the environmental communication and spatial organisation are important. The work of Passini et al. (1998; 2000) concurred with the findings of Netten (1989) and built on it by placing an emphasis on the need to provide a clear, distinct circulation, good signage and visual access to other parts of the building. This research has complemented many of these existing findings and extends on the knowledge base, particularly in the cases highlighting issues experienced with symmetry, T-junctions, homogeneity and repetitive elements. The hierarchy of spaces within the architectural layout must be carefully considered to avoid creating out of bounds areas. The benefits of signage, views to other spaces and providing adequate access to outdoor spaces were also results within this research.

The significance of each of the design typologies have on supporting wayfinding was summarised in Section 4 and Figures 5 - 8. Problems with symmetry, particularly in the central area of F2 were recorded. F3 demonstrated how T-junctions can cause confusion. Whereas the linear plan of F4 has the fewest number of changes in direction and decision points which may simplify wayfinding. Marquardt and Schmieg (2009) concluded that the linear plan with no directional changes was the most supportive of wayfinding. However, that is not to say that F4 is flawless as it had poor access to outdoor space and presented frustrating dead ends. F5's circuit type plan shared common issues of T-junctions and symmetry. Elmståhl et al. (1997) found that circuit plans were less confusing. Although this paper viewed the circuit type plan F5 in a positive light, there were still some layout issues which affected wayfinding.

It is important that good design for dementia is coupled with quality care, this is highlighted by Broady (1966) who places a caveat on environmental determinism, explaining that design alone cannot overcome social issues.

Downs and Stea (1973) explain that it is important for the designer to acquire an understanding of how the spatial experience will be interpreted so that a successful architecture may incorporate a series of spatial ideas. The implication of dementia means that wayfinding becomes more problematic, particularly in complex and larger typologies like the long term care setting. The role of the design of the physical environment for people with dementia has gained increasing recognition since the 1980s (Fleming et al., 2011). With a limited number of studies examining the architectural design of dementia specific long term care settings, this research has an application for architectural practice. It has highlighted issues which should be considered throughout the design process.

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[Accessed 27/08/14].

Figure 1: *Selected fieldwork sites and associated accommodation within the layout, left to right from top: F2 (Y-shape), F3 (H-shape), F4 (linear plan) and F5 (circuit type/figure of eight plan).*

	F2 	**F3** 	**F4** 	**F5** 	**Total**
Type of care home	**Residential**	**Nursing**	**Nursing**	**Residential**	
Participants in wayfinding walks	4	4	1	5	**14**
Wayfinding walks (repeated measures design)	4x3= 12	4x3= 12	1x3= 3	(3x3)+ (1x2)+ (1x1)= 12	**39**

Table 1: *A summary of the number of people who participated in and observed wayfinding walks and the number of walks completed in total.*

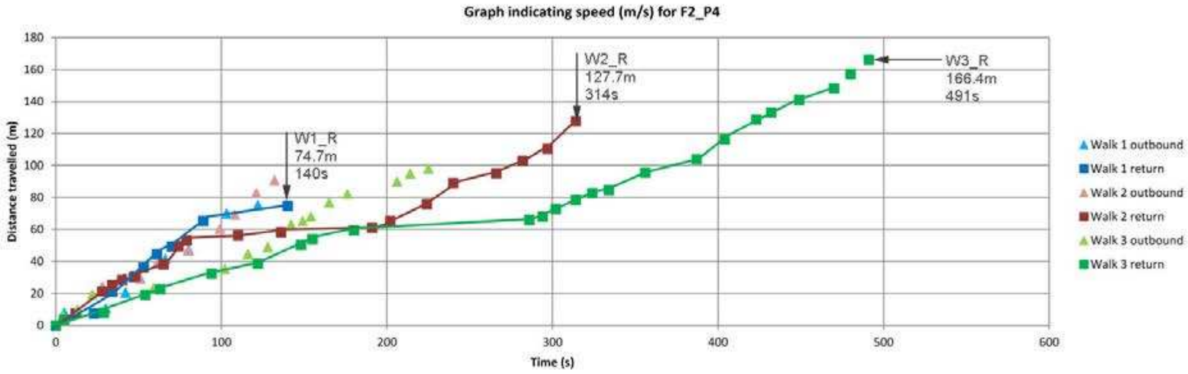

Figure 2: Graph indicating speed for the return walks for F2_P4.

This shows a reduced performance as the walks go on (a common theme for many of the participants). Walk three is the least efficient as it covers a longer distance due to wayfinding errors and takes a longer period of time.

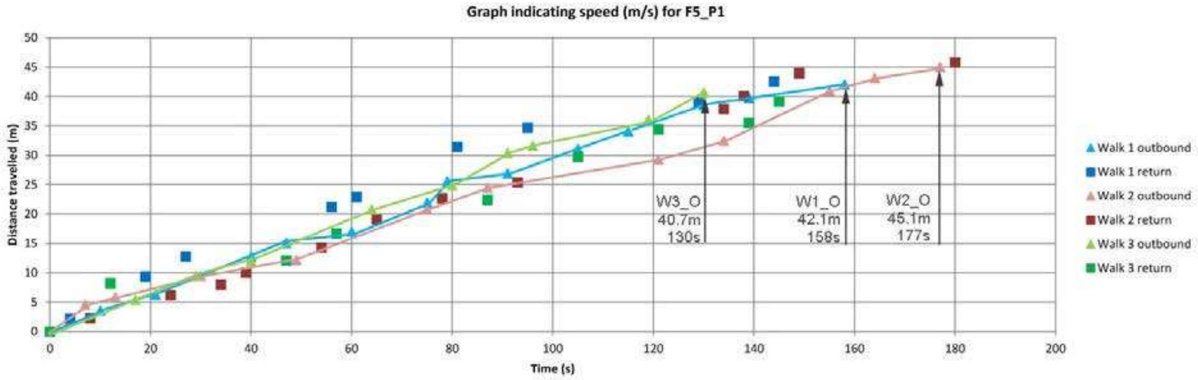

Figure 3 Outbound journey of F5_P1 walks.

Anomalies are shown where the performance on walk two is the poorest and there is improvement shown on walk three which may indicate exhaustion and/or learning.

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F2	Distance (m)						Time (s)						Average Speed (m/s)						Number of Prompts/Pauses						Demographics				
	W1		W2		W3		W1		W2		W3		W1		W2		W3		W1		W2		W3		Age	Gender	Dementia	Stage (MMSE)	Action Capability
	O	R	O	R	O	R	O	R	O	R	O	R	O	R	O	R	O	R	O	R	O	R	O	R					10m walk test (m/s)
P1	31.0		31.0		31.0		88		106		88		0.35		0.29		0.35		0		1		0		85	F	Age related	Mild (20-25)	0.32
P2	31.0		31.0		35.5		44		76		82		0.70		0.41		0.43		0		2		4		87	F	Age related	Mild-moderate (1-22)	0.70
P3	21.8	20.6	21.3	21.3	22.7	24.3	69	183	122	65	113	165	0.32	0.11	0.17	0.32	0.20	0.15	3	3	5	2	2	4	89	F	Alzheimer's	Moderate-severe (7-12)	0.21
P4	75.3	74.7	90.7	127.7	98.1	166.4	122	140	132	314	225	491	0.61	0.53	0.69	0.41	0.44	0.34	1	0	4	6	4	7	99	F	Age related	Moderate-severe (7-12)	0.59
Mean	39.8	47.7	43.5	74.5	46.8	95.4	80.8	161.5	109.0	189.5	127.0	328.0	0.50	0.32	0.39	0.37	0.36	0.25	1	2	3	4	3	6	90				0.46
St. Devn	24.1	38.3	31.8	75.2	34.6	100.5	32.9	30.4	24.5	176.1	66.7	230.5	0.19	0.30	0.22	0.06	0.11	0.13	1	2	2	3	2	2	6.22				0.23

F3	Distance (m)						Time (s)						Average Speed (m/s)						Number of Prompts/Pauses						Demographics				
	W1		W2		W3		W1		W2		W3		W1		W2		W3		W1		W2		W3		Age	Gender	Dementia	Stage (MMSE)	Action Capability
	O	R	O	R	O		O	R	O	R	O	R	O	R	O	R	O	R	O	R	O	R	O	R					10m walk test (m/s)
P1	60.9	46.3	48.0	51.5	63.2	6	145	111	116	112	152	148	0.42	0.42	0.41	0.46	0.42	0.44	3	1	2	1	1	2	79	M	Vascular	Moderate (14)	0.42
P2	57.1	67.6	47.0	48.1	45.3	4…	132	182	62	61	106	82	0.43	0.37	0.76	0.79	0.43	0.56	2	3	3	2	2	1	89	F	Vascular	Late (6)	0.38
P3	55.7	54.4	54.0	54.3	63.3	54.4	100	97	58	57	190	116	0.56	0.56	0.93	0.95	0.33	0.47	1	1	1	2	3	2	82	F	Alzheimer's	Moderate (15)	0.56
P4	54.8	55.9	70.0	53.4	67.8	75.0	95	77	97	67	84	111	0.58	0.73	0.72	0.80	0.81	0.68	1	1	3	1	1	3	73	M	Korsakoff's	Moderate-late (7)	0.65
Mean	57.1	56.1	54.8	51.8	59.9	60.3	118.0	116.8	83.3	74.3	133.0	114.3	0.50	0.52	0.71	0.75	0.50	0.54	2	2	2	2	2	2	80.8				0.50
St. Devn	2.7	8.8	10.6	2.7	10.0	12.7	24.3	45.7	28.0	25.5	47.4	27.0	0.08	0.16	0.22	0.21	0.21	0.11	1	1	1	1	1	1	6.65				0.13

F4	Distance (m)						Time (s)						Average Speed (m/s)						Number of Prompts/Pauses						Demographics				
	W1		W2		W3		W1		W2		W3		W1		W2		W3		W1		W2		W3		Age	Gender	Dementia	Stage (MMSE)	Action Capability
	O	R	O	R	O	R	O	R	O	R	O	R	O	R	O	R	O	R	O	R	O	R	O	R					10m walk test (m/s)
P1	65.1	97.2	83.4	89.9	67.0	52.3	242	172	373	334	262	251	0.27	0.57	0.22	0.27	0.26	0.21	3	3	1	2	3	3	84	F	Vascular/Alzheimer's	Moderate-late (6)	0.30
Mean						75.8						272.3						0.30						3					
St. Devn						17.1						71.4						0.13						1					

F5	Distance (m)						Time (s)						Average Speed (m/s)						Number of Prompts/Pauses						Demographics				
	W1		W2		W3		W1		W2		W3		W1		W2		W3		W1		W2		W3		Age	Gender	Dementia	Stage (MMSE)	Action Capability
	O	R	O	R	O	R	O	R	O	R	O	R	O	R	O	R	O	R	O	R	O	R	O	R					10m walk test (m/s)
P1	42.1	42.6	45.1	45.8	40.7	39.2	158	144	177	180	130	145	0.27	0.30	0.25	0.25	0.31	0.27	3	2	3	2	2	2	74	F	Alzheimer's	Mild-moderate (19)	0.28
P2	41.0	42.4	41.9	43.2	38.6	40.2	131	128	162	183	152	189	0.31	0.33	0.32	0.24	0.25	0.21	1	1	2	3	2	3	71	F	Vascular	Mild-moderate (20)	0.32
P3	45.0	43.5					225	221					0.20	0.20					3	3					89	F	Alzheimer's	Moderate (14)	0.19
P4	60.9	61.4	62.0	60.8	58.0	63.4	89	102	103	103	95	75	0.68	0.60	0.70	0.59	0.61	0.85	0	1	0	1	0	1	80	F	Age related	Mild-moderate (20)	0.64
P5	43.1	39.9	43.1	43.6			165	149	113	156			0.26	0.27	0.38	0.28			2	3	1	2			83	M	Vascular	Moderate-late (13)	0.35
Mean	46.4	46.0	48.0	48.4	45.8	47.6	153.6	148.8	138.8	155.5	125.7	136.3	0.34	0.34	0.41	0.34	0.39	0.44	2	2	2	2	1	2	79.4				0.36
St. Devn	8.2	8.7	9.4	8.4	10.6	13.7	49.8	44.3	36.3	37.0	28.7	57.5	0.19	0.15	0.20	0.17	0.19	0.35	1	1	1	1	1	1	7.16				0.17

Table 2: Quantitative data from the walks conducted in each of the fieldwork sites.

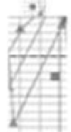
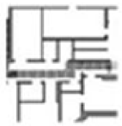
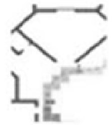
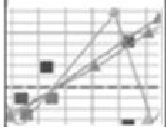
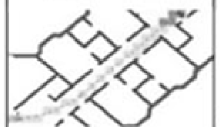
Distance (m)	Time (s)	Speed b/w points (m/s)	Colour	Point on plan	Conversation	Behavioural effect	Graph	Alert!	Map	Image
Outbound										
0	0	0	Blue	1	R: So P4 I'd like you to walk to the parlour with me today, X's room. P4: The fancy room down the corridor or the other one? R: That's right the one down the corridor with all the nice furniture in it. P4: Oh aye the fancy one…well you keep me right. R: Yes ok.	P4 & R commence walk.				
8	May-16	1.6	Red	2	P4: And did you see I have a wee bathroom too. It's not very big but it's good and handy. R; Well it's lovely to have it so handy. P4: Yeah it's handy. R: Yeah it's great. P4: It's alright it's not beautiful but it's there and it's mine and nobody else is using it.	P4 opens door of bathroom & shows it to R. There is a pause to chat about the bathroom.		Acceleration		
10.6	30	0.1	Blue-green	3	R: Yes. It's very good to have. P4: Oh yes.	P4 commences walking again.		Deceleration		
20.5	42	0.83	Yellow-orange	4	P4: You see the floor dips down here…I know this off by heart. R: So you know when the ramps are coming? P4: Aye (laughs)…I don't even notice it.	P4 comments on the ramps on the floor.		Acceleration		
29.2	51	0.97	Orange-yellow	5	R: So we're just going down to X's room then.	P4 & R continue to walk. TV is audible from common area.				
41.5	66	0.82	Yellow-orange	6		P4 & R turn corner.				
47.6	80	0.44	Yellow-green	7	P4: What do I have to do? R: We're just walking down to the parlour here P4 ok? P4: Aye.			Deceleration		
69.9	103	0.97	Orange-yellow	8	P4: You see the wee room in there? R: Yeah that's the other dining room. This is us here in the parlour. P4: Oh it's all set up for tomorrow's party.	P4 & R turn to go into parlour.		Acceleration		

Figure 4: Excerpt of data from Microsoft Excel sheets used to examine the empirical data and in the synthesis of results.

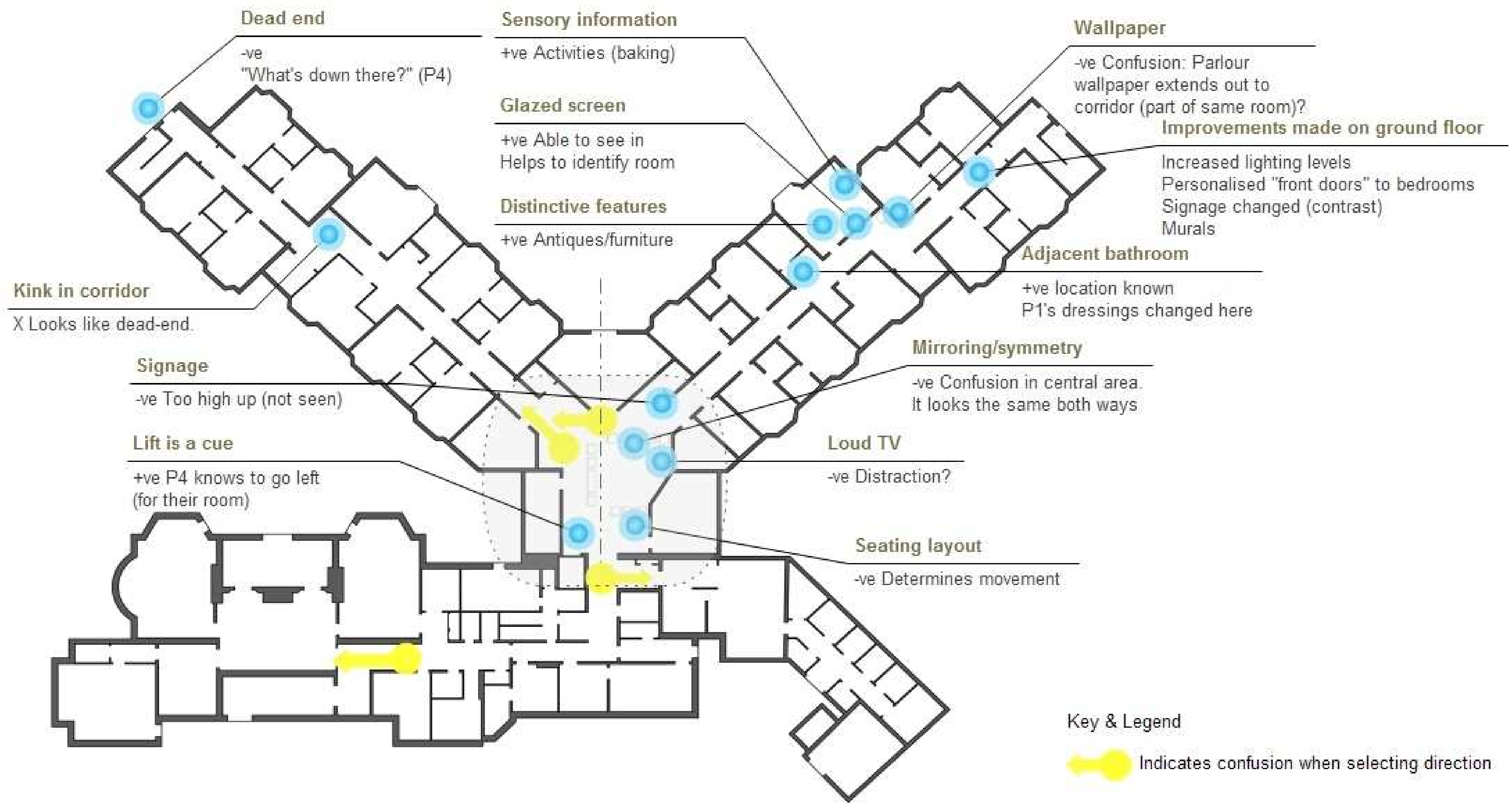


Figure 5: Example of a visual summary of the wayfinding issues that were observed as part of the wayfinding walks in the Y-shape plan (F2).

Many of the illustrated issues were prevalent in the other fieldwork sites, particularly with regards to symmetry, junctions and central areas

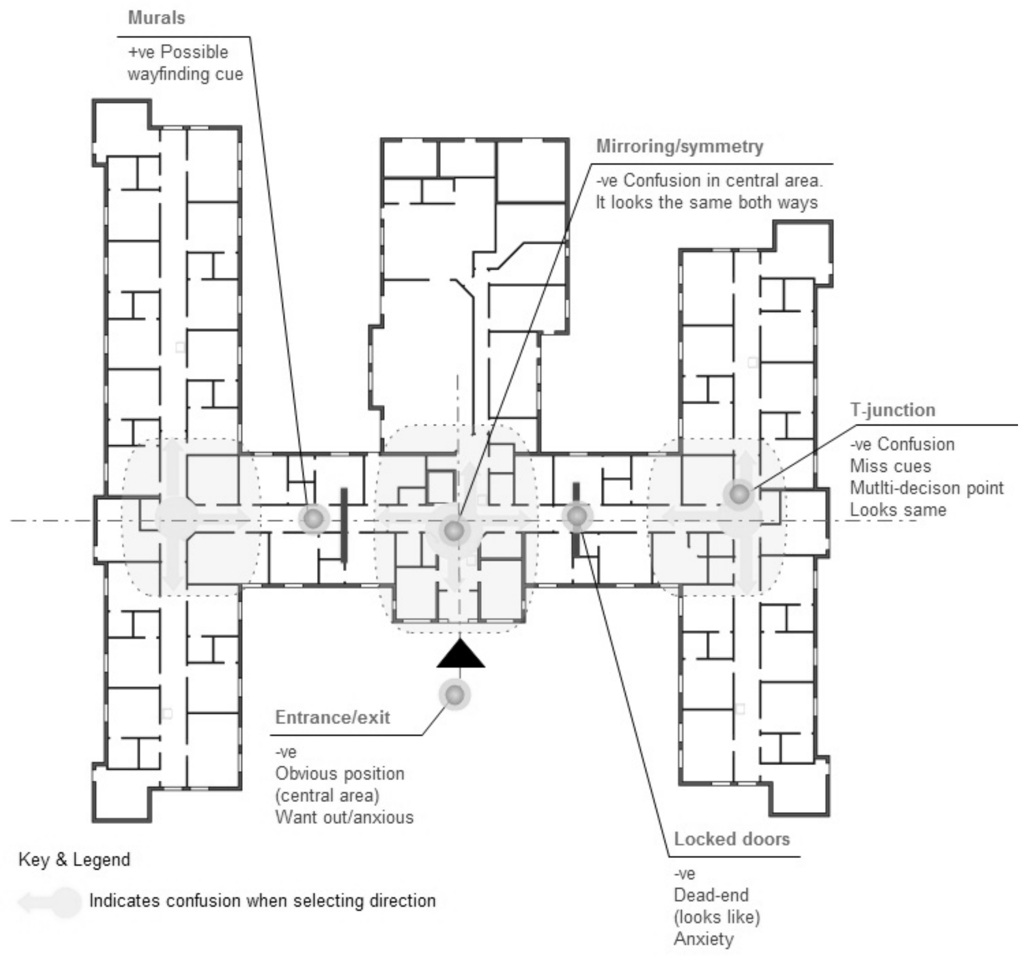


Figure 6: Example of a visual summary of the wayfinding issues that were observed as part of the wayfinding walks in the H-shape plan (F3).

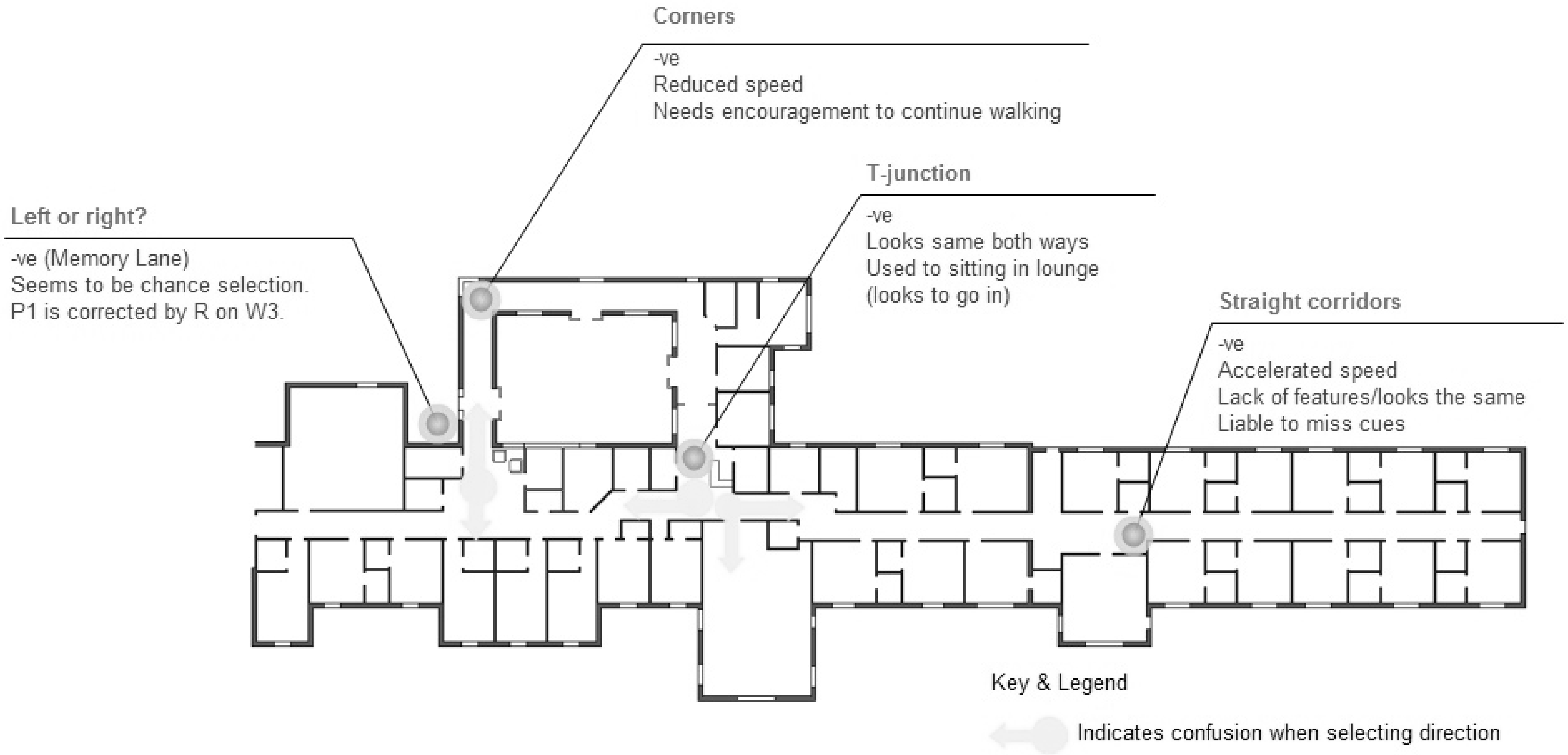


Figure 7: Example of a visual summary of the wayfinding issues that were observed as part of the wayfinding walks in the linear plan (F4).

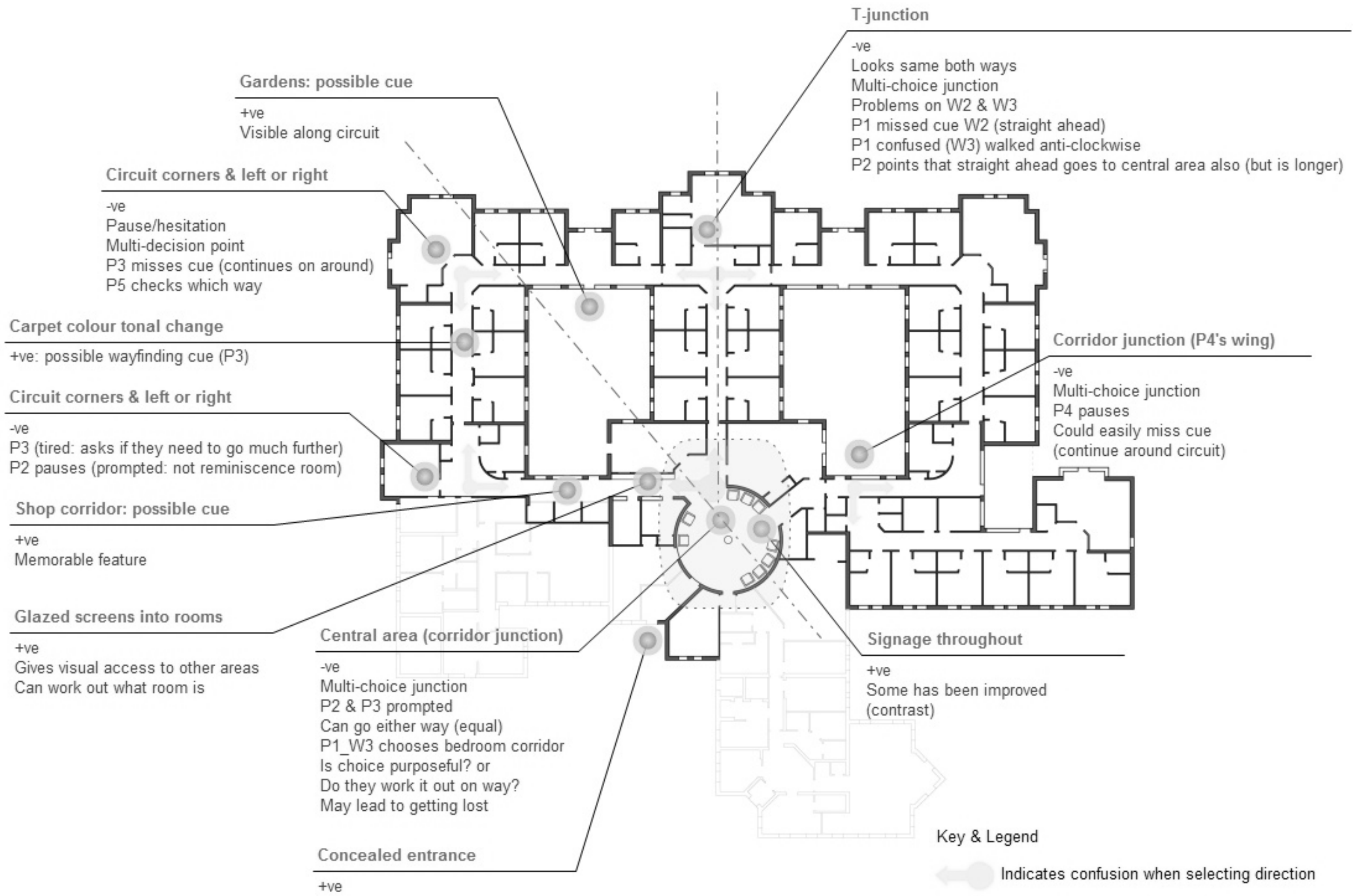


Figure 8: Example of a visual summary of the wayfinding issues that were observed as part of the wayfinding walks in the circuit plan (F5).

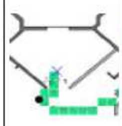
Point on plan	Conversation	Behavioural effect	Graph	Action	Map	Image
	R: P2 could you walk me to the parlour or X's room where you do activities? I'll be with you along the way if you need help or want to ask questions or have a P2: Ok.	P2 commences walk.				
1	R: Sorry P2...it's down this way...I want you to take me to the parlour. P2: Where's that? R: X's room where you do your baking and activities. P2: Oh aye. R: The same place as the other time...this way. P2: Well you tell me where to go and I'll go. R: This way.	P2 turns to LHS and looks at R gestures with left arm to the left. (5 second pause). R points with right hand to the left.		Initial acceleration Wrong direction		

Figure 9 An excerpt of combined data from F2_P2_W3 showing common symmetry problem.

Above is an excerpt from the behavioural mapping data sheet (collated in a matrix) where F2_P2 took a wrong turn. The lanyard camera images below show a sequence of what was actually seen.