Hallways in the eyes of patients with moderate dementia

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Abstract

Inevitably, moving into elderly care facilities causes distress. The elderly need to develop emotional bonds with their new place. Place attachment is manifested through affective, cognitive and behavioural psychological processes, and influenced by social and physical characteristics of places. A knowledge gap exists regarding physical place characteristics enhancing place attachment and identity. In research, physical place characteristics are explained in words, but memorized as configurations, such as visuals. The challenge is addressing places as bundled characteristics. Combining 3D-virtual-reality and discrete choice modelling provides an innovative solution to improve the design of elderly care facilities and enhance self-regulatory processes in elderly.
The questionnaire was piloted amongst 33 residents with dementia who were taken into residential care. Outcomes suggest that residents with dementia tend to prefer sensory less difficult to interpret hallways.

Introduction

Moving into elderly care facilities causes distress to the elderly, who from 75 years of age face increasing impairments due to chronic conditions (Chorus, Gijsbers, van Staalduinen, & Wevers, 2011). The numbers of elderly people over 75 years old is expected to increase from 1,1 million in 2011 to 2,5 million in 2040. In 2010, 260.000 people received institutionalized care (VWS, 2011). The elderly need to develop emotional bonds with their new place of residence to enhance psychological and emotional well-being, such associated with less problematic behaviour (Van Assche et al., 2013).

The development of emotional bonds takes time and depends on length of residence [2]. The relationship between place attachment and length of residence is not linear. The highest increment in attachment occurs in the first years of residence [2], but also depends on residential history [28], age and gender. Not only more women than men reside in elderly care [10], but women might also spent more time at home than did men.

For those moving into elderly care facilities, establishing place attachment is important to reduce distress and enhance self-regulatory processes. An individual is more emotionally attached to places with symbolically meaningful memories and connections to the past (Andersson, 2011; Lewicka, 2011; Scannell & Gifford, 2010). Elderly care facilities frequently address symbolic links to former places by supplying cues to the past, i.e. view from window to farmland, use of antique-like china, etc.

Following the Person-Process-Place (PPP) framework of Scannell and Gifford (Scannell & Gifford, 2010), place attachment involves affective, cognitive and behavioural connections to a place (see Figure 2). Place identity is related to place attachment, since place is a fundamental component of personal identity (Hernández, Carmen Hidalgo, Salazar-Laplace, & Hess, 2007; Proshansky, Fabian, & Kaminoff, 1983). Through interactions with places, people describe themselves as belonging to a specific place. Place attachment and place identity are not identical, as place attachment developed before place identity (Hernández et al., 2007). The behavioural dimension of place attachment is founded in the desire to remain close to a place (Scannell & Gifford, 2010). However, the behavioural dimension is also thought to include behaviour, such as engaging in neighbouring and other social activities [(Lewicka, 2005, 2011; Scannell & Gifford, 2010).

For many years, interests in social dimensions of place attachment have been stronger than interests in its physical dimensions (Lewicka, 2011; Van Assche et al., 2013). According to Stedman (2003) individuals feel attached to places through symbolic links, thus for the meaning they assign to physical features themselves, rather than feeling attached to actual physical place characteristics. Stedman (2003) asked respondents to memorize lakes they owned or frequently visited, but did not provide any visual information. A recall from memory may well be more likely to evoke symbolic links to places, as memorizing may activate affective dimensions (Lengen & Kistemann, 2012).

Generally, in studying the physical dimensions, place attachment and place identity research focuses on independent (assisted) living (Perkins, Ball, Whittington, & Hollingsworth, 2012; Van Assche et al., 2013). Empirical evidence regarding the physical characteristics enhancing place attachment in residential care is lacking (Lewicka, 2011; Rodiek & Fried, 2005; Scannell & Gifford, 2010; Stedman, 2003; Van Assche et al., 2013). However, studies addressing the influence of physical place characteristics on wellbeing of elderly in residential care suggest that physical place characteristics do matter (Blackman, van Schaik, & Martyr, 2007; Edgerton & Richie, 2010; Fleming, Fay, & Robinson, 2012; Marquardt, 2011; van Hoof, Kort, Duijnstee, Rutten, & Hensen, 2010; van Liempd, Hoekstra, Jans, Huibers, & van Oel, 2009; Zeisel et al., 2003; Zuidema, De Jonghe, Verhey, & Koopmans, 2010). Residential care environments conventionally designed for the cognitively able appear to put stress on the cognitive abilities of sufferers of Alzheimer's (Zeisel et al., 2003). It has been argued that the elderly might have increasingly difficulties in "sensory comprehension of spaces", since place attachment also depends on one's cognitive abilities, the elderly might have increasingly difficulties in "sensory comprehension of spaces" (Slaughter, Calkins, Eliasziw, & Reimer, 2006; Zeisel et al., 2003).

In the Netherlands, due to changed legislation a transition is taking place in which the elderly will stay living at home for longer with assisted care. Institutionalized care providers face profound changes for their real estate properties. The transition currently adds to redundancies in some types of elderly care

facilities, and re-developments or new developments. Current guidelines for residential care settings were developed for a population with less demanding care profiles than nowadays applies [10] and underscore the need for further research into the “sensory comprehension of spaces”. Many elderly care providers will need to adapt their facilities to a more severely cognitively impaired group of residents . They must prepare their residential settings for a more homogeneous population all requiring more intensive care than formerly. These institutionalized care settings might directly benefit from knowledge of improving place attachment for the elderly (Van Assche et al., 2013).

This study aims to fill the knowledge gap concerning the physical characteristics of places supporting place attachment and place identity (Hernández et al., 2007; Lewicka, 2011; Scannell & Gifford, 2010)]. Regarding physical place characteristics, studies focused on urban and geographical characteristics, largely ignoring architectural and interior design (Lewicka, 2011). Studying physical dimension of places is complicated as these characteristics are processed and memorized as configurationally information (Hoegg & Alba, 2008; Lengen & Kistemann, 2012). Therefore, places are better described as visuals than in words (van Oel & van den Berkhof, 2013). Another challenge is addressing places as bundled rather than separate characteristics as has been done by ‘photo-shopping’ single features in pictures (Rodiek & Fried, 2005). Combining 3D-virtual-reality and discrete choice modelling provides an innovative solution to investigate which physical place characteristics facilitate place attachment in the elderly taken into elderly care. This innovative approach is used to study attachment to physical dimensions of places (Lewicka, 2005, 2013). To date, no study has investigated these differences , even though they are highly relevant to the elderly’s emotional and psychological wellbeing (Van Assche et al., 2013). Moreover, unlike studies addressing the influence of physical place characteristics on wellbeing of elderly in residential care, we will include the dementia sufferer’s own valuation of what physical place characteristics best afford their wellbeing. Typically, studies used expert opinion or observational data in assessing the influence of physical place characteristics on wellbeing of patients in psychogeriatric care settings (Blackman et al., 2007; Edgerton & Richie, 2010; Fleming et al., 2012; Marquardt, 2011; van Hoof et al., 2010; van Liempd et al., 2009; Zeisel et al., 2003; Zuidema et al., 2010). However, people with moderate cognitive impairments were able to reliable self-report quality of life (van Baalen, Vingerhoets, Sixma, & de Lange, 2011) and engaged in a virtual reality tour to navigate a virtual environment (Blackman et al., 2007). Particularly van Baalen et al. (2011) mentioned that there are discrepancies between reports of quality of care from a patient’s perspective using self-report and proxy reports, observations and judgements by formal and informal caregivers. Therefore we aim to a new approach that combines 3D-virtual-reality with discrete choice modelling, which was previously successfully used in identifying characteristics of interest in design (Orsborn, Cagan, & Boatwright, 2009; van Oel & van den Berkhof, 2013).

The general research question of this study is to investigate to what extent physical place characteristics themselves contribute to place attachment in dementia sufferers in elderly care. To answer the general research question, the following sub questions were formulated:

- Is it possible to use 3D virtual reality designs to assess place attachment of people with moderate severe dementia?
- Are there any differences in the ensemble of physical place characteristics that best affords wellbeing of dementia sufferers according to their own preferences and their family caregivers and the nursing staff, respectively?

We hypothesize that dementia sufferers prefer a simple ensemble of physical place characteristics, as place attachment partially depend on one’s cognitive abilities (Scannell & Gifford, 2010) and have increasingly difficulties with the “sensory comprehension of spaces” (Zeisel et al., 2003). This stems from poorer inhibition of uptake of irrelevant information in spatial memory with advancing age (Klencklen, Després, & Dufour, 2012), though other spatial cognitive deficits, and attention and emotion may be involved as well (Klencklen et al., 2012; Lengen & Kistemann, 2012). An over-complex sensory environment impacts negatively on the elderly’s behavior, evoking e.g. verbal aggression, agitation and withdrawal (van Liempd et al., 2009; Zeisel et al., 2003).

Measuring valuations

Generally, research conceptualizing physical dimensions of residential care settings for people use

semantic checklists and questionnaires. However, verbal descriptions of spaces have low internal validity, as respondents recall different images from their mind that fit descriptions [4-6]. Visualization in 3D-virtual-reality not only fits better the way the information about places is processed and memorized in the brain [4], but also allows investigation of the concurrent effects of several physical place characteristics (see Figure 1). Using architectural design software makes it possible to systematically vary several physical place characteristics simultaneously. This new approach that combines 3D-virtual-reality with discrete choice modelling was successfully in identifying characteristics of interest in design [6, 30]. Therefore, we here discuss the general methodology used for quantifying preferences for design of hallways in residential settings. In both marketing research (Kuhfeld, 2010) and engineering design research (Orsborn, Cagan, & Boatwright, 2009), utility functions have been successfully employed to ask people to value characteristics of a designed space. A utility function is a tool used by economists to describe a person's utility, that is, the valuation gained by using a certain good or service. A benefit of a utility function is that it can represent a complex space in which many 'design factors' or 'attributes' each account for a dimension. A utility function offers a means to describe the relationship of all these attributes to a person's utility (Orsborn, et al., 2009). In evaluating a set of multiple attributes, a person will maximize his or her personal utility function, and therefore utility functions can be used to determine an optimal set of trade-offs between several design characteristics (Kuhfeld, 2010; Orsborn, et al., 2009).

In measuring the utility for a product, one can distinguish between the revealed and the stated preference method (Adamowicz, Louviere, & Williams, 1994). The former is based on observation of the actual choices made by individuals, and it assumes that people reveal their preferences by their actions. However, an evaluation of existing settings would not easily relate persons' valuation to utility functions, because revealed preferences research only captures peoples' opinion on economic goods, like rent levels, cost for energy and heating, etc. (Hanley, Wright, & Adamowicz, 1998). As we were interested in assessing preferences for hallways by asking people to choose from a set of pictorial representations, we asked them for their stated preferences.

A common way to assess valuations is therefore the two-alternative or referendum question. This so-called contingent valuation choice method is to be distinguished from the discrete choice experiments. A discrete choice experiment is a sequence of multinomial choice questions (Adamowicz, Boxall, Williams, & Louviere, 1998). Discrete choice experiments are characterized by two elements. First, a person is

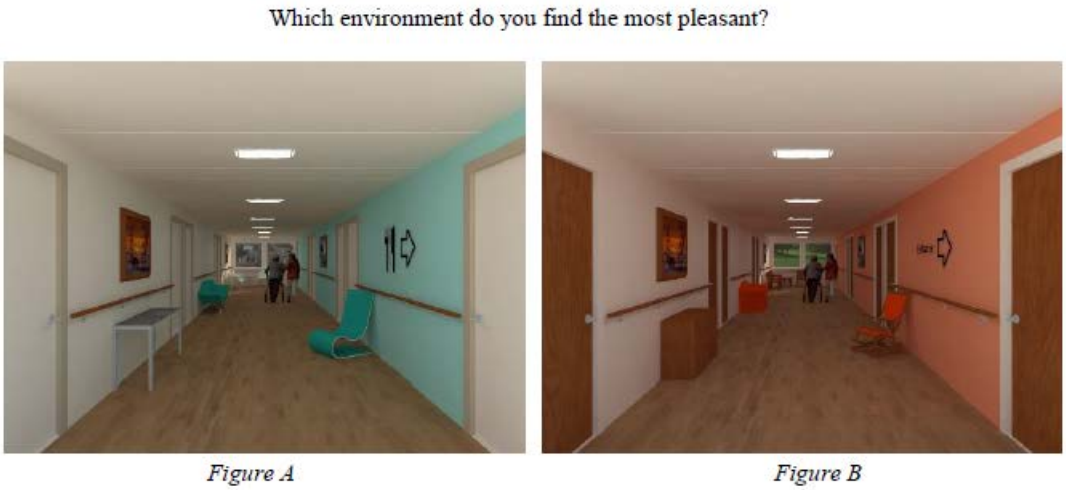


Figure 1 Example of question with 3D-Virtual Reality design

asked to make a discrete choice between two or more discrete alternatives in a choice set; second, the alternatives in a choice set are constructed by means of an experimental design that varies one or more attributes within and/or between persons in such a way that information related to preference parameters of an indirect utility function can be inferred (Carson & Louviere, 2011; Kuhfeld, 2010). There is some evidence that discrete choice experiments are better in estimation and provide a better understanding of the choices made by persons than the contingent valuation method using a referendum approach (Mogas, Riera, & Bennett, 2006).

Pilot study

We decided to do an explorative study to identify relevant physical place characteristics in small unit residential care settings in the Netherlands. Observations were made in 8 small unit residential care settings, 3 were constructed between 2004 and 2009; and 5 were constructed since 2009. Of these, 4 were situated in urbanized areas, and 4 were situated in rural areas.

Table 1 Assessment of the 8 small scale residential care units according to the quality of physical place characteristics (qualitative scored as +, 0, -).

	A	B	C	D	E	F	G	H
Floor plan and Dimensioning								
Clear and easy to grasp floor plan	+	+	+	+	+	+	+	+
Living – size of > 8 m^2 per person	+	-	-	+	-	+	+	+
Private sleeping room of > 15 m^2 per person	+	+	+	+	+	+	+	+
Mobility and Wayfinding								
Attractive mobility circuitry with sufficient lighting and visual and auditory cues, stimuli	+	0	0	-	+	-	+	0
Presence of signs and cues to support wayfinding	-	-	-	-	0	-	-	-
Outdoor space / garden with sufficient space for mobility,/ circuitry	+	+	+	+	+	-	-	-
Autonomy								
Contrasts between wall and floor, functional demarcations supporting autonomy	+	-	+	+	+	+	-	+
Distinctive functions, useful contrasts and good lighting bathroom	+	-	-	0	-	-	-	-
Open kitchen enabling clients to involve in preparing meals	+	-	-	+	+	+	+	+
Walking supports along walls	-	+	-	+	-	-	+	-
Privacy								
Own sleeping room	+	+	+	+	+	+	+	+
Homelike atmosphere								
Homelike and recognizable interior design	+	+	+	0	+	0	+	+
Furniture and decoration reflecting age of clients	0	+	+	+	0	0	+	+
Old fashioned recognizable forms, music, and photo/video stills	0	+	0	0	0	0	0	0
Security and Safety								
Safety equipment is unobtrusively designed /placed	+	+	+	+	+	+	+	+
A safe garden or alley allowing autonomous access	+	+	+	+	-	+	+	+
Sensory comprehension								
Sufficient daylight access, additional artificial lighting	+	0	-	+	+	+	0	+
Camouflage of doors	-	-	-	-	-	-	+	-
Corners with attributes for sensory stimulation	-	0	-	-	-	0	+	0
Use of soft materials to enhance acoustics	-	-	-	-	+	-	-	-
Social areas								
Social areas encouraging interaction	+	+	0	0	0	-	+	0

Observations were made using a checklist based on the checklist used by van Liempd et al. (2009) and Stroobants and Verhaest (2012). Categories included:

1. Floor plan and Dimensioning
2. Mobility and Wayfinding
3. Autonomy
4. Privacy
5. Homelike Atmosphere

6. Security and Safety
7. Sensory stimulation
8. Social areas

Table 1 provides an overview of the qualitative assessment of these physical place characteristics. We were also keen to involve practitioners in the field in order to draw upon their expertise. We therefore interviewed experts before deciding which main design characteristics to use in the further study. We conducted interviews with 7 experts. The interviewees comprised two architects, one design and styling expert, one geriatrist, a project manager in a residential care setting, and two nursing staff members.

During the interviews, the interviewees were asked to rank the importance of the design of residential care setting relative to other factors that potentially influence the atmospherics of these settings. These factors, which were taken from a literature review and based on the researchers' own ideas, were (ranked according to their revealed importance): 1. Wayfinding; 2. Quality of the floor plan; 3. Sensory comprehension; 4. Homelike Atmosphere; 5.Mobility/ circuitry; 6. Autonomy; 7. Social interaction; 8. Safety; and 9. Privacy. The interviews were further used to identify physical place characteristics that were considered necessary(i.e. quality of lighting) or supportive (colouring, materialization, presence of a garden, indoor greenery, signs for wayfinding and objects of art).

The current study

Methods

For the purpose of this study and considering the results of the pilot study, it was decided to focus on the hallways, because wayfinding was considered as one of the most important features in the card sorting. Furthermore, hallways are important to encourage active behaviour and support wellbeing as these are part of mobility circuitry (Marquardt, 2011).

Participants

There are 3 groups of participants, residents of a psychogeriatric department (n=33), their family caregivers (n=28) and nursing staff (n=39) of in total 4 different locations of a care institution in the Netherlands. The responsible location manager obtained proxy informed consent from the residents' family caregivers and asked the resident to participate in the study. In a face-to-face setting, we explained the study once more and asked for permission again. We provided the resident with two photos of 3D virtual reality designs, each printed in full colour in A4. There were 5 sets of 2 photos and all residents indicated their preference for one of the 3D designs in a set. As might be expected, there were more women (82%) than men (18%). Their average age was 87 years; the youngest was 69 years old, whereas the oldest was 95 years old. We found no significant relationship between age and gender. Most of the residents had a care indication of 5 (97%), which means that they need care for 24 hrs a day and cannot live at their own, also under current law. Only 3% had a care indication of 4 and were in stage 1 of dementia. All others were either in stage 2 (n=15) or stage 3 (n=15) of dementia. None of them were in the latest stage of dementia.

Relatives filled out an online version of the questionnaire. Most of the family caregivers took care of one of their parents (n=19), one of them was a brother or sister, and there were 8 relatives who were otherwise related, most of them being a niece/nephew. There were 9 male (32%) and 19 (68%) female family caregivers. Their average age is 60 years. Respondents were asked for their highest completed educational level according to Dutch standards. The grading in educational answering categories was designed so that respondents could easily find the appropriate answer, but this yielded low cell counts in some cells. Therefore, primary education, lower/intermediate secondary education, higher secondary education and junior/intermediate vocational education were recoded into low level of education; the remainder were recoded into high level of education. There were 15 (54%) relatives having with a low level of education; 13 (46%) had received a high level of education.

Like the relatives, nursing staff also filled out an online version of the questionnaire. Most of staff were women (n=36, 92%); only 3 were men (8%). About 25% had between 1 and 5 years at a psychogeriatric department; nearly 25% worked at such department between 6 and 10 years; another 25% had between 11 and 15 years of work experience; and the remaining worked at such department for 16 years or more. Their average age was 47 years. Most (n=14) had intermediate vocational training; 36% had obtained a high level of education.

Materials

We used discrete choice experiments to measure respondents' preferences for design characteristics of passenger areas (Kuhfeld, 2010). As explained by Kuhfeld (2010), we intended to use a multinomial logit (MNL) model to estimate the design factors (or 'attributes') from the choices the respondents made from the alternatives. However, we were not able to include sufficient residents with dementia and therefore we used generalized logistic regression analyses instead, which does not take into account that actually paired choices were made.

We first developed an experimental design in SAS. Considering the impaired cognitive abilities of residents with dementia we decided to have only 4 design factors varying within a pair of 3D virtual reality designs. This is below the short term memory load as put forward by Miller (1956). We finally decided to use 11 design factors, of which 9 had 2 levels and 2 had 3 levels. We did not use the full factorial design, because there would have been as too many unique images possible, using 9 design factors with 2 levels and 1 attribute with 3 levels (2*2*2*2*2*2*2*2*2*3*3). Moreover, in the questionnaire, respondents were asked to choose between two images of a hallway in a discrete choice set (see Figure 1). With this number of images, there are 10,616,832 ((4608*4608)/2) unique pairs to make. We therefore used an algorithm that optimized the number of pairs using a partial profile model derived in SAS (Kuhfeld, 2010). Because of time limits we developed 50 discrete choice sets of two 3D virtual reality designs each. Since we considered this too much for dementia sufferers to deal with, we made ten versions of the questionnaire with 5 discrete choice sets each. From the experimental design we obtained a detailed prescription of what 3D virtual design characteristics should be present in each image of a choice set, and such for all choice sets in the ten versions of the questionnaire.

A questionnaire was developed using discrete choice modelling and 3D-virtual reality designs of a hallway. The outcomes of the pilot study were considered in deciding about the design factors to be visualized in the images. The design factors that were varied were:

1. Signage (text, pictograms or none): in the 3D designs this was visualized as

(Text) (Icon)

2. Outdoor View (greenery, urban)

(Greenery)

(Urban view)

3. Colour scheme (warm, cold, white)
   For the warm colour scheme a salmon colour was used (see the right part of Figure 1), whereas a light blue colour as an alternative, as well as creamy white (RAL 9001);

4. Art (painting, sculpture)

(2D painting)

(3D sculpture)

5. Spatial layout (curved, straight),

(Bended)

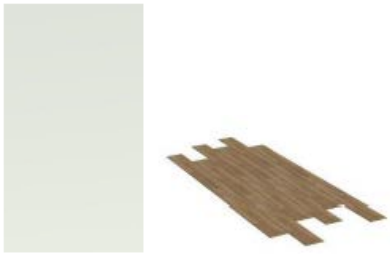
(Straight)

6. Lighting (warm, cold),

(Warm)

(Cold)

7. Materialisation Wall and Floor (smooth, embossed),



(smooth wall, laminate floor)

(Embossed wall, carpet floor)

8. Interior (modern, antique-like)

(Modern)

(Antique-like)

9. Greenery (present, absent),

(Greenery)

10. Dimensioning (narrow, wide,)
The dimensioning was modelled after the dimensioning as found in the site visits and was either 1.80 meters (narrow) or 3.60 meters (wide)

11. Social area (waiting room like arrangement of chairs, home like supporting social contacts)

(row -waiting room- arrangement)

(home like, supporting interaction)

A summary of the different levels varied in the 3D virtual reality designs is also provided in Table 2. Figure 1 shows an example of a question.

Table 2 Overview of factors and levels per factor used in the 3D virtual reality designs

Design factor	Level 1	Level 2	Level 3
1. Signage	Text	Icons	None
2. Outdoor view	Greenery	Urban view	
3. Color scheme	Warm	Cold	White
4. Art	2D Painting	3D Sculpture	
5. Spatial Layout	Bended	Straight	
6. Lighting	Warm	Cold	
7. Materialisation Wall, Floor	Smooth	Embossed	
8. Interior	Modern	Antique-like	
9. Greenery	Present	Absent	
10. Dimensioning	Narrow	Wide	
11. Social Area	Row	Home-like	

Procedure

We used a random number table to decide which version to use per resident. In the online version of the questionnaire (for family caregivers and nursing staff), respondents were randomized into one of the ten versions of the questionnaire.

The questionnaire for the family caregiver and the nursing staff started with questions asking for demographic information. This was followed by 5 visual choice experiments asking for what in their opinion was most affording their own wellbeing. Thereafter the same 3D virtual reality designs were presented along with the question to choose the one that best afforded either the wellbeing of their relative or dementia sufferers. The latter was preceded by a small text block explaining that dementia sufferers need a balanced environment with not too much or too less stimuli.

Results were analysed in SAS 9.2; SPSS 21.0 was used in additional analyses. Multinomial logit models were used to model the relationships between a polytomous response variable and a set of regressor variables. Multinomial logit models are a broad class of models. Generalized logit models were used to model customer choices. The generalized logit model was used to analyse the choices as a function of the characteristics of the individual making the choice. Because of a lack of data no conditional logit model was used to analyse the choice among the two alternatives as a function of the characteristics of the alternatives. A threshold of $p < 0.05$ was used in significance testing of the main effects.

Results

In Table 3 the preferences of dementia sufferers according to their own choices are summarized. Table 4 shows what informal and formal caregivers thought what design characteristics afford wellbeing of dementia sufferers. The importance of the selected factor in choosing the 3D design that best affords wellbeing of dementia sufferers is shown as the estimated utility of all factors. The higher the estimated absolute utility, the more weight the characteristic has in deciding about the importance of the design characteristic. For example, a white colour scheme has the highest affordance relative to a cold colour scheme both according to dementia sufferers (OR = 2.01) and caregivers (OR=2.37), meaning it is the most important factor in choosing the most situation that best affords people with dementia. The reference level here is a cold colour scheme and this has a much lower likelihood to be chosen than a white colour scheme. The odds ratio (OR) is 1.0 if both alternatives are equally preferred. The OR shows that the what an impact a factor has. It is two times more likely that the image will be chosen if there is a white colour scheme than if a blue colour scheme was used. In comparing Table 3 and Table 4, it seems

that there are some important discrepancies to mention. It seems that caregivers choose against a blue colour scheme, since caregivers preferred either white (OR=2.37) or warm colour schemes (OR=1.88), and both odds ratios are within each other's 95% confidence intervals. Thus since the OR of white colours (2.27; Table 4) remains within the risk limits of the OR for cold colours (1.24 – 2.85), we conclude that white colours are not preferred over warm colours. However, those suffering from dementia seem to prefer white colours over cold colours and following the same reasoning, also preferred white colours over warm colours. A tentative conclusion here might be that people suffering from dementia tend to look for a less stimulating environment, which is less clear if cognitively abled are trying to stand in their shoes even though it was suggested that dementia sufferers are thought to benefit from less stimuli. One other suggestion that those with dementia tend to choose a restorative environment stems from their preferences for an outdoor view to greenery over an urban view (OR=1.54 Table 3). Since we currently have very low numbers, this is only a marginally significant effect, but as a hypothesis it deserves further research.

Not only the disliking of a cold colour scheme by caregivers seem to suggest that it is very difficult to put oneself in the shoes of someone else, who is generally much older and cognitively disabled. Caregivers also considered dimensioning of the hallway important (OR=1.70, p <0.05) which is easy to understand as assisting an elderly is more easy in hallways that are more spacious. However, the materialization was included in the 3D virtual reality designs, because professional caregivers explicitly mentioned that they preferred smooth materialization for feasibility of cleaning. The alternative, with soft materials –i.e. carpet instead of laminate – was considered the preferred materialisation as it is thought to positively affect acoustics. The professionals'' preference for smooth materialization over embossed finishing of the wall along with carpeting of the floor being best from the cognitive disables elderly's perspective could be accordingly interpreted (OR=1.41, p<0.05)

Table 3 Preferences of dementia sufferers

Characteristic	Reference characteristic	Df	Est.	SE	X^2	p	OR	95%CI OR
1. Intercept		1	-1.50	0.49	9.4	<0.01		
2. Signage (icons)	None	1	0.53	0.31	2.9	0.09	1.32	0.79 – 2.19
3. Signage (text)	None	1	0.00	0.31	0.0	0.99	1.37	0.85 – 2.22
4. Outdoor view (greenery)	Urban view	1	0.43	0.26	2.7	0.10	1.54	0.92 – 2.59
5. Colour scheme (warm)	Cold	1	0.00	0.32	0.0	0.99	1.00	0.54 – 1.86
6. Colour scheme (white)	Cold	1	0.70	0.31	5.1	0.02	2.01	1.10 – 3.67
7. Art (painting)	Sculpture	1	0.20	0.25	0.7	0.41	1.22	0.76 – 1.98
8. Spatial Layout (straight)	Bended	1	0.28	0.26	1.1	0.29	1.38	0.79 – 2.19
9. Lighting (Warm)	Cold	1	0.29	0.25	1.3	0.26	1.33	0.81 – 2.18
10. Materialisation (Smooth)	Embossed	1	-0.02	0.25	0.0	0.91	0.97	0.59 – 1.60
11. Interior (Antique-like)	Modern	1	0.26	0.26	1.0	0.31	1.30	0.78 – 2.15
12. Greenery (present)	Absent	1	0.27	0.24	1.3	0.26	1.31	0.82 – 2.12
13. Dimensioning (wide)	Small	1	0.32	0.25	1.7	0.20	1.37	0.85 – 2.22
14. Social Area (row-like)	Home-like	1	0.16	0.25	0.4	0.53	1.30	0.78 – 2.15

Table 4 Preferences of dementia sufferers according to family and professional caregivers

Characteristic	Reference characteristic	Df	Est	SE	X^2	p	OR	95%CI OR
1. Intercept		1	-1.54	0.33	21.7	<0.01		
2. Signage (icons)	None	1	-0.07	0.22	0.10	0.75	1.23	0.87 – 1.72
3. Signage (text)	None	1	0.28	0.19	2.10	0.14	1.33	0.91 – 1.94
4. Outdoor view (greenery)	Urban view	1	0.11	0.17	0.51	0.48	1.13	0.81 – 1.56
5. Colour scheme (warm)	Cold	1	0.63	0.21	8.71	0.00	1.88	1.24 – 2.85
6. Colour scheme (white)	Cold	1	0.86	0.21	17.4	0.00	2.37	1.58 – 3.55
7. Art (painting)	Sculpture	1	0.17	0.16	1.02	0.31	1.18	0.86 – 1.63
8. Spatial Layout (straight)	Bended	1	0.20	0.17	1.37	0.24	1.22	0.87 – 1.72
9. Lighting (Warm)	Cold	1	0.17	0.17	1.10	0.29	1.19	0.86 – 1.65
10. Materialisation (Smooth)	Embossed	1	0.35	0.17	4.08	0.04	1.41	1.01 – 1.98
11. Interior (Antique-like)	Modern	1	0.08	0.17	0.23	0.63	1.09	0.78 – 1.51
12. Greenery (present)	Absent	1	0.09	0.16	0.31	0.60	1.09	0.80 – 1.50
13. Dimensioning (wide)	Small	1	0.53	0.17	9.84	0.00	1.70	1.22 – 2.38
14. Social Area (row-like)	Home-like	1	0.19	0.16	1.41	0.23	1.22	0.88 – 1.68

Discussion

In this study we investigated to what extent physical place characteristics themselves contribute to place attachment in dementia sufferers in elderly care. Since research into physical place characteristics affecting the well-being of dementia sufferers does not generally ask for their own assessments but instead rely on expert opinions either from professional or family caregivers, we first raised the question whether it would be possible to ask people with dementia themselves to choose from a set of 3D virtual reality design which best affords their well-being. We found that such was clearly possible and we had not the impression that a random choice was made. Even people in moderate severe stages of dementia were able to indicate their preferences. Visual information is normally processed at multiple levels within the visual system. People with dementia experience impaired high level vision and object recognition at early stages of their disease. However, the major deficit underlying poor visual processing is semantic impairment (Tippett, Blackwood, & Farah, 2003). Therefore the use of such 3D virtual reality worked well. Considering the early deficits that come along with dementia it is rather unexpected that caregivers did not have a clear preference for the icons over text or no signage used to support wayfinding.

An important finding of the present study is that we found supportive evidence, be it in a very small sample, for our hypothesis that dementia sufferers prefer a less sensory stimulating environment as may be inferred from their clear preference of a hallway with a white colour scheme over a cold or a warm colour scheme. It is thought that coloured objects are more easily recognized (Oliva & Schyns, 2000) and a white colour scheme may facilitate recognition as it reduces the sensory complexity of the space. Our results are therefore consistent with the conceptual framework of the Model of Belonging and Agency, Aging Well and the Environment (Wahl, Iwarsson, & Oswald, 2012) which furthers Lawton and Nahemow (1973) Environmental Press Model.

At the same time, our results suggest that evidence based on other than self-assessment lack validity as of what physical place characteristics best affords wellbeing of dementia sufferers. Our results suggest that expert opinion fails to properly assess the sensory complexity of a space. Their preferences for both a white and a warm colour scheme over a cold colour scheme may not reflect a judgement based on the sensory complexity of a space, but may reflect expected problems in viewing bluish colours due to yellowing of the eye (van Hoof et al., 2010). The difficulty in stepping aside one's own preferences is further apparent in the choice for a smooth, easy cleanable wall finish and a laminate floor over an embossed wall finishing and carpeting of the floor, as well as the preference for a wider dimensioning of the hallway.

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