Controlling the Stimulation of Senses in Design for Dementia

Arnout Siegelaar[1], Froukje Boersma[2], Sytse U. Zuidema[3], and Mark P. Mobach[4]

Citation:
Siegelaar, A., Boersma, F., Zuidema, S.U., and Mobach, M.P. (2020) Controlling the stimulation of senses in design for dementia, In the Companion proceedings of the European Facility Management International Conference 2020, EFMIC 2020, 1 October 2020, online conference.

ABSTRACT

Background and aim – This study applied deduced critical success factors for sensory stimulation of individuals with dementia in a real-life architectural design in The Netherlands. The design was prepared by an architect, a consultant, and staff; and subsequently assessed by family members in a meeting applying interactive virtual reality. The aim was to determine if virtual reality would allow for improvements of a preliminary evidence-based design.

Methods – A combined approach of desk research and action research, based on deduction and application, building information modelling, virtual reality, and questionnaires with different stakeholders.
Results – Ten critical success factors to sensory stimulation were derived from literature: lighting, noise, sensory clues, visibility, orientation clues, wayfinding, interior, space, spatial articulation, and privacy. All factors were applied in the design of a nursing home special care unit. Family members showed neutral or positive evaluations on most factors. However, when compared with the current old building, the new building design was evaluated lower for its capabilities of interaction (staff, fellow residents) and orientation. The results also suggest positive expectations with respect to sensory stimulation, for instance, spatially-related possibilities for privacy, active behaviors, and autonomy.
Originality – The study reports on a combination of classical deductive methods, practical application, action research, and virtual reality. It shows that active engagement of family members of people with dementia, by applying virtual reality in an open discussion, can improve a deduced evidence based design.**Practical or social implications –** Active engagement of family members in the assessment of an evidence based design does not only improve architectural design, but also our understanding of the mechanisms of action of architecture for individuals with dementia and their spatially-related needs.
Type of paper – Research paper.

KEYWORDS

Action research, application, deduction, dementia, evidence based design, healthcare, virtual reality.

INTRODUCTION

Evidence exists that the built environment has an impact on the well-being of individuals with dementia (Calkins, 2009). Even a small improvement in environmental quality can make a large difference for the competence of a person with major limitations (Ferdous & Diaz Moore, 2015). It is pre-supposed here that a better understanding of the influences of environmental characteristics in individuals with dementia can improve their well-being and quality of life. Thus, it is our challenge to re-dedicate our efforts, to develop appropriate environmental strategies, and to implement them in practice (Brawley, 2001). The societal relevance is high, because poor well-being leads to behavioral problems in healthcare institutions. And caregivers are the ones to deal with these problems, creating an even higher work pressure and a potential risk of work overload and sick leave. In the context of our study in The Netherlands this problem will increase. The number of individuals with dementia is expected to double to half a million people over the next 25 years (Alzheimer Nederland, 2019) on an estimated population

[1] Hanze University of Applied Sciences / University Medical Center Groningen / University of Groningen / Woonzorgconcept, The Netherlands, e-mail: arnout@woonzorgconcept.nl
[2] University Medical Center Groningen / University of Groningen, The Netherlands
[3] University Medical Center Groningen / University of Groningen, The Netherlands
[4] Hanze University of Applied Sciences Groningen / The Hague University of Applied Sciences, The Netherlands

of 18 million (Stoeldraijer, van Duin, & Huisman (2017). Hence, society can potentially benefit from environments that respond to the needs of people with dementia. May the built environment perhaps even be regarded as a preve ntive medicine? (Brawley, 2001).

In this context, several researchers have published relevant literature reviews providing a wonderful overview of the field (e.g., Fleming, Crookes, & Sum, 2008; Van Hoof, Kort, Duijnstee, Rutten, & Hensen, 2009; Marquardt & Schmieg, 2009). A common theme in these reviews is the concept of controlling sensory stimulation. Marquardt, Bueter, & Motzek (2014) have argued that there is sufficient evidence available to come to a consensus on the positive effect of appropriate sensory environments on agitation in people with dementia. However, they contend that findings also indicate a need to control sensory stimulation preventing a reverse effect. The balance between sensory overstimulation or sensory overload and sensory deprivation seems to be key (Day, Carreon, & Stump, 2000). Furthermore, controlling sensory stimulation is needed to allow for individual differences and preferences, in accordance with person-centered care, described by Kitwood (1997). This means that that the amount of sensory stimulation needs to be adjusted to individual persons with dementia, or to put it differently, that the building/ rooms should allow different intensities/ ranges of sensory stimulation.

This paper explores the meaning and scope of controlling sensory stimulation in a nursing home special care unit (SCU) in The Netherlands. Moreover, it describes the elaboration of strategies that are expected to enhance control in this architectural design.

METHODS

First, we established relevant features of the physical environment that are known to play an important role in sensory stimulation. The features were derived from scientific literature, allowing us to define critical success factors. Second, we formulate strategies to elaborate these factors in the design of the SCU. Third, an interactive design was presented to staff and family (next of kin) of individuals with dementia in a 3D-rendering through Building Information Modelling (BIM) on a life size screen. The presentations were given by the architect and a consultant, the walkthrough was performed by an experienced gamer, and the session was moderated by a supervisor of the research team. The design was evaluated by the participants on eight dimensions, of which four are relevant in the current stage of the design: Privacy, Social Interaction, Support of Orientation and Autonomy.

RESULTS

Critical success factors

From literature 10 critical success factors to sensory stimulation were derived (Table 1). The factors consisted of lighting, noise, sensory clues, visibility, orientation clues, wayfinding, interior, space, spatial articulation, and privacy.

Table 1 Critical success factors to sensory stimulation.

	Critical success factor		Reference
1	Lighting	Lighting improves visibility, circadian rhythm, sleep patterns	Garre-Olmo et al., 2012; Van Hoof et al, 2009
		Bright-light therapy reduces agitation	Cohen-Mansfield, 2001; Marquardt et al., 2014
		Vision and light levels influence independence	Van Hoof et al., 2009
2	Noise	Noise is related to confusion, poor sleep, distraction, fear, agitation	Garre-Olmo et al., 2012
		Sounds and noise trigger confusion	Van Hoof et al., 2009
3	Sensory clues	Multi-sensory clues reduce unwanted behavior	Marquardt et al., 2014
		Meaningful decision points improve orientation	Marquardt & Schmieg, 2009
		Reference points and visible endings of a corridor improve orientation	Marquardt & Schmieg, 2009
		Meaningful sensory input—activity sounds, resident sounds, activity levels, smells, lighting, colors, heat, & touch	Zeisel et al., 2003

	Critical success factor		Reference
4	Visibility	Ability to locate dining room from bedroom improves orientation	Bidewell & Chang, 2010
		Physical prompts (yellow doors, mirrors on doors) improve finding	Cohen-Mansfield, 2001
		Strong color contrast improves visibility	
		Direct visible access to relevant spaces improves orientation	Marquardt et al., 2014
		Activity spaces at end of paths	Marquardt & Schmieg, 2009
		Visibility of outside-area's improves finding	Zeisel et al., 2003
			Marquardt & Schmieg, 2009
5	Orientation clues	Visual clues: signs improve orientation	Van Hoof et al., 2014
		Visual clues: ensure visibility, minimize clutter improves orientation	Van Hoof et al., 2014
		Landmark recognition helps orientation	Kessels, 2011
6	Wayfinding	Straight lay-out, simple structures of circulation space improve orientation	Marquardt & Schmieg, 2009
7	Interior	Home-like, residential personalized environment	Marquardt et al., 2014; Zeisel et al., 2003
		Unique designs of common spaces, non-repetitive	Marquardt & Schmieg, 2009; Zeisel et al., 2003
8	Space	Spatial generosity, accessibility, small scale per dwelling unit enhance freedom, social contacts	Van Steenwinkel, 2017; Marquardt & Schmieg, 2009
9	Spatial articulation	Enhanced / natural environments	Marquardt et al., 2014
		Legibility of functions of places	Marquardt & Schmieg, 2009
		Well-ordered, identifiable places improve orientation	Van Steenwinkel et al., 2014
10	Privacy	Degree of privacy-personalization reduces aggression	Zeisel et al., 2003

Design strategies in preliminary design of a Dutch SCU

The current design is in a preliminary stage. Therefore, the design features are limited to the site of the nursing home (location), lay-out, spacing, and the use of lighting/natural light. The site of the design and the floorplan are included in Figures 1 and 2 respectively. Table 2 shows the elaboration of each critical success factors into a related design strategy.

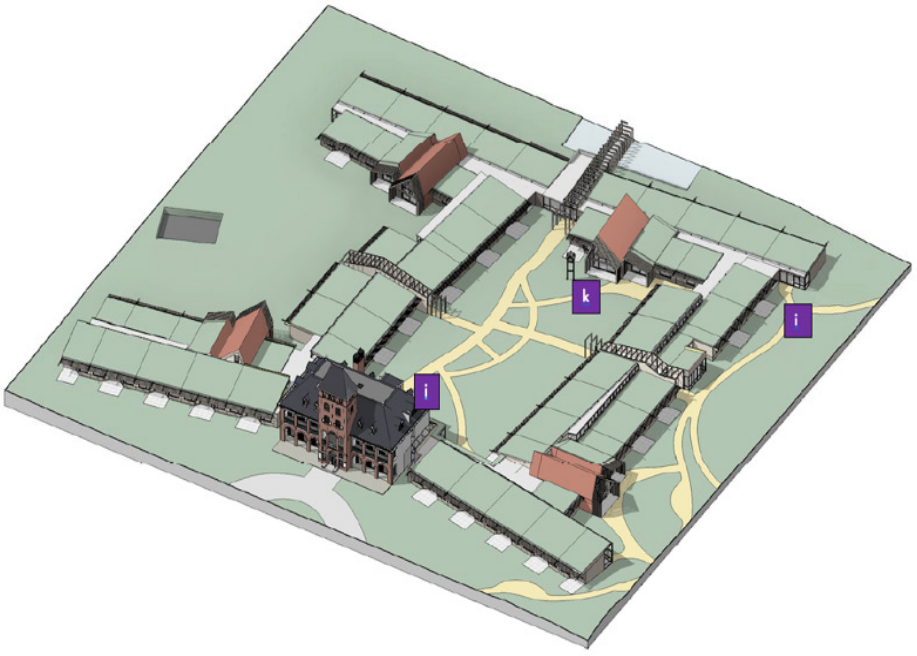

Figure 1 Site plan (©MAAK Architectuur/Nexit Architecten).

Figure 2 Floorplan (©MAAK Architectuur/Nexit Architecten).

Table 2 Design strategies to implement critical success factors.

	Critical success factor		Related design strategy	List, Fig 2
1	Lighting	Lighting improves visibility, circadian rhythm, sleep patterns	Northbound skylights in circulation space	a
		Bright-light therapy reduces agitation	Large windows in living rooms, bedrooms and circulation space	b
		Vision and light levels influence independence		
2	Noise	Noise is related to confusion, poor sleep, distraction, fear, agitation	Low noise levels on location	c
		Sounds and noise trigger confusion		
3	Sensory clues	Multi-sensory clues reduce unwanted behavior	Living rooms have unique view; 2 different lay outs per group	d
		Meaningful decision points improve orientation	Circulation space varies in width and context	e
		Reference points and visible endings of a corridor improve orientation	Doors living rooms and activity rooms are open; sounds, sight and smells are noticeable form circulation space	f
		Meaningful sensory input—activity sounds, resident sounds, activity levels, smells, lighting, colors, heat, & touch		
4	Visibility	Ability to locate dining room from bedroom improves orientation	The design is built up in units of 20 rooms and 2 living rooms	g
		Physical prompts (yellow doors, mirrors on doors) improve finding	Living rooms are protruding into the circulation space for visibility and to facilitate entering by wanderers.	h
		Strong color contrast improves visibility		
		Direct visible access to relevant spaces improves orientation		
		Activity spaces at end of paths		
		Visibility of outside area's improves finding	One story building; outside areas are visible and accessible from everywhere	i
5	Orientation clues	Visual clues: signs improve orientation	See strategies h and i	
		Visual clues: ensure visibility, minimize clutter improves orientation		
		Landmark recognition helps orientation	Old building is a landmark and adds to variety	
			Living rooms recognizable from outside	j
				k

	Critical success factor		Related design strategy	List, Fig 2
6	Wayfinding	Straight lay-out, simple structures of circulation system improve orientation	Simple square structure; see strategies h and i.	l
7	Interior	Home-like, residential personalized environment	See strategy d, living rooms are decorated in different styles.	
		Unique designs of common spaces, non-repetitive		
8	Space	Spatial generosity, accessibility, small scale per dwelling unit enhance freedom, social contacts	Generous space in circulation space, living rooms and outside covered wandering paths.	m
9	Spatial articulation	Enhanced / natural environments	See strategy d	
		Legibility of functions of places	Only single function spaces, old building is an exterior and interior landmark	n
		Well-ordered, identifiable places improve orientation		
10	Privacy	Degree of privacy-personalization reduces aggression	Single bedrooms	o

End-user evaluation

In a 3D-rendering presentation of the BIM-model, family members of 6 residents of the present SCU, and one member of staff evaluated the design. Participating family members were asked to represent all 27 residents with dementia. Participants of the interactive design session filled out a questionnaire evaluating the design on eight dimensions, of which four are relevant for controlling sensory stimulation. Participants were asked to evaluate the design, using a 7-point Likert scale, assessing a) the present accommodation and b) the design of the new accommodation.

Table 3 Evaluation of the results (N=7).

Items		Average	
		a	b
		Current (before 3D)	Expected (after 3D)
1	Privacy		
a	There are sufficient places to withdraw and to be alone	5.33	6.67
b	There are sufficient places to withdraw and not be disturbed by unwanted stimuli	5.00	6.67
c	Residents have insufficient personal space	2.00	5.00
2	Social interaction		
a	Residents have sufficient interaction with staff	6.00	5.60
b	Residents have sufficient interaction with fellow residents	5.80	5.67
c	Residents have sufficient interaction with visitors	5.33	5.60
d	Residents have sufficient interaction with other people	5.20	5.50
e	There are sufficient room and places to engage in social interaction	4.83	6.80
3	Support of orientation		
a	The building offers sufficient challenges to come into action	3.50	6.50
b	The building supports orientation in place	4.60	3.60
c	The building supports orientation in time	5.00	4.40
d	The building triggers curiosity as to what's behind the corner	4.00	6.00

Items		Average	
		a	b
		Current (before 3D)	Expected (after 3D)
4	Autonomy		
a	There are sufficient choices in activities	3.20	4.50
b	There are sufficient different atmospheres /environments to choose from	2.80	6.25
c	There is sufficient variety in attractive places to dwell	3.83	6.33

The results show that end-user evaluation after the design session was neutral or positive. The items 2a and 2b (interaction with staff or fellow residents) and 3b and 3c (orientation support) were assessed lower. (The current SCU design will be changed to improve these items.) The results also suggest positive expectations with respect to sensory stimulation, for instance, spatially-related possibilities for privacy, active behaviors, and autonomy.

CONCLUSION

The current approach, using virtual reality of a SCU design to allow family members of individuals with dementia to scrutinize design quality, has revealed benefits. Firstly, end user-participation provides useful feedback for architects, allowing them to refine their design. Secondly, the current approach is helpful in imagining a new built environment and actively engages family members of individuals with dementia in a new building design, and by doing so, allows them to prepare for a new situation in which their beloved ones will come to live.

REFERENCES

Alzheimer Nederland. (2019). *Factsheet cijfers en feiten over dementie*. Retrieved from website: www.alzheimer-nederland.nl/factsheet-cijfers-en-feiten-over-dementie

Bidewell J.W., & Chang, E. (2010), Managing Dementia Agitation in residential aged care, *Dementia* 10(3) 299-315, doi: 10.1177/1471301211407789

Brawley, E.C. (2001), Environmental design for Alzheimer's disease: A quality of life issue. *Aging & Mental Health,* 5:sup1, 79-83, doi: 10.1080.713650005

Calkins, M.P. (2009). Evidence-based long term care design. *NeuroRehabilitation*, 25, 145-154, doi: 10.323/NRE-2009-0512

Cohen-Mansfield, J., (2001) Nonpharmacological Interventions for Inappropriate Behaviors in Dementia, *American Journal of Geriatric Psychiatry,* 9:4 Fall 2001, doi: 10.1007/s11940-013-0257-2

Day, K., Carreon, D., & Stump, C. (2000), The Therapeutic Design of Environments for People With Dementia: A Review of the Empirical Research, *The Gerontologist* 40, 397-416, Retrieved from https://academic.oup.com/gerontologist.

Ferdous, F., & Diaz Moore, K. (2014). Field observations into the Environmental Soul: Spatial Configuration and Social Life for People Experiencing Dementia. *American Journal of Alzheimer's Disease & Other Dementias* 30(2), 209-218, doi: 10.1177/15333317514545378

Fleming, R., Crookes, P.A., & Sum, S. (2008) *A review of the empirical literature on the design of physical environments for people with dementia*. Retrieved from: https://ro.uow.edu.au/cgi/viewcontent.cgi?article=3923&context=hbspapers

Garre-Olmo, J., López-Pousa, S., Turon-Estrada, A., Juvinyà, D., Ballester, D., & Vilalta-Franch, J., (2012) Environmental Determinants of Quality of Life in Nursing Home Residents with Severe Dementia, JAGS 60, 1230-1236, doi: 10.1111/j.1532-5415.2012.04040.x

Kessels, R.P.C., Van Doormaal, A., & Janzen, G. (2011), Landmark Recognition in Alzheimer's Dementia: Spared Implicit Memory for Objects Relevant for Navigation, *PLoS ONE*, 6(4) 1-7, doi:10.1371/journal.pone.0018611

Kitwood, T. (1197), *Dementia Reconsidered: The Person Comes First*, Bristol, 1997

Marquardt, G., Bueter, K., & Motzek, T. (2014), Impact of the design of the Built Environment on People with Dementia: An Evidence-Based Review, *Health Environments Research & Design Journal,* 8(1), 127-157

Marquardt, G., & Schmieg, P., (2009), Dementia-Friendly Architecture: Environments That Facilitate Wayfinding in Nursing Homes, *American Journal of Alzheimer's Disease & Other Dementias.* 24(4), 333-340. doi: 10.1177/1533317509334959

Stoeldraijer, L., van Duin, C., & Huisman, C. (2017). Bevolkingsprognose 2017–2060: 18,4 miljoen inwoners in 2060. Den Haag: Centraal Bureau voor de Statistiek.

Van Hoof, J., Kort, H.S.M., Duijnstee, M.S.H., Rutten, P.G.S., & Hensen, J.L.M. (2009) The indoor environment and the integrated design of homes for older people with dementia. *Building* and Environment, 45(2010), 1244-1261, doi :10.1016/j.buildenv.2009.11.008

Van Hoof, J., Marquardt, G., & Demiris, G., (2014) in O'Brien, D. (Ed.). *Evidence Based Design* Journal 1: Aged Care, 1-69, Retrieved from: http://ebdjournal.com/journals/aged-care

Van Steenwinkel, I., Dierckx de Casterlé, B., & Heylighen, A. (2017) How architectural design affords experiences of freedom in residential care for older people, *Journal of Aging Studies,* 41(2017), 84-92, doi: 10.1016/j.jaging.2017.05.001

Zeisel, J., Silverstein N.M., Hyde, J., Levkoff, S., Lawton, M.P., & Holmes, W. (2003) Environmental Correlates to Behavioral Health Outcomes in Alzheimer's Special Care Units, The Gerontologist 43(5) 697-711. doi:10.1093/geront/43.5.697

ACKNOWLEDGEMENTS

Prof. Mark Mobach and his research team would like to gratefully acknowledge the honour of receiving Delta Prize (in Dutch 'Deltapremie') handed by Ingrid van Engelshoven, Minister of Education, Culture and Science, in The Netherlands in November 2019. The authors of the papers in companion proceedings of the European Facility Management International Conference 2020 are grateful to acknowledge the support of the Netherlands Association of Universities of Applied Sciences and the Dutch Taskforce for Applied Research. They also thank EuroFM for the collaboration and the possibilities for sharing their results and ideas with the EuroFM community.

Deltapremie

The 'Deltapremie' or Delta Prize is a new leading research prize in the Netherlands focusing on practice-oriented research by professors. The prize is developed for professors who have managed to repeatedly make a special difference with the social impact of their research over the years. It shows where practice and research can come together in an innovative way. Practice-oriented research has acquired a solid place in Dutch society. Almost 700 professors and more than 3,000 teacher-researchers are currently involved. The starting point of the research is always to find solutions for practice-based problems, also by partnering with practice. In this way, practice-oriented research provides applicable solutions to societal challenges.

An independent selection committee selected the winners. The committee consisted of six experts from Erasmus University Rotterdam, Innofest, Delft University of Technology, Netherlands Study Centre for Technology Trends, and the Association of Netherlands Municipalities. In the report the selection committee tributes Mark Mobach and his research group for the impact that they have on the crossroads of various domains from public transport to mental health. Mobach: "We see the prize as enormous encouragement to continue our research into space and organisation in healthcare, education, offices, and cities together with our partners. We extend our research to areas where there are perhaps fewer financial possibilities, such as research with the arts and frailty."

Research focus area

With his research group, Prof. Mobach wants to contribute to the best buildings for people and organisations. He does so by devising better space and services in a multidisciplinary setting together with students, lecturer-researchers, Ph.D.-students, and postdocs. Better spaces and services for education, offices, and even cities that stimulate healthy behaviour, better healthcare buildings that reduce stress, but also prisons and stations that better meet the needs of society.