GREAT
Persuasive Ambiences

Get Ready for Activity – Ambient Day Scheduling with Dementia

Final Summary Report

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AAL PROGRAMME

This document forms part of the Research Project "Get Ready for Activity – Ambient Day Scheduling with Dementia (GREAT)" funded by the AAL 2016 "Living well with dementia" funding program as project number AAL-2016-023. The GREAT project will produce the following Deliverables:

D1.1 Medical, psychological, and technological framework
D2.1 Applicable hardware components
D2.2 Applicable software components
D2.3 Field tested hardware components
D2.4 Field tested software components
D3.1 Implementation report
D3.2 Field test report
D4.1 Communication strategy
D4.2 Stakeholder management report
D5.1 Report on market analysis
D5.2 Dissemination plan
D5.3 Intermediate business plan and business model
D5.4 Exploitation plan
D5.5 Final business plan and business model
D6.5 Final project report
D6.5 Final summary report

The GREAT project and its objectives are documented at the project website http://great.labs.fhv.at. More information on GREAT and its results can also be obtained from the project consortium:

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Contents Page

Abstract

Light, sound and aroma therapy resp. care are often used in the treatment of people with dementia as a complementary medical method. However, there is often a lack of systematisation and individualisation in the application of these approach. Information and communication technology allow to create light, sound and aroma fitted to individual requirements and/or systematically controlled in line with therapy plans. A precisely programmed dosage of the interventions or an automatic adjustment of light, sound and aroma to the individual needs of a person is thereby possible.

GREAT is the very first solution that performs a coordinated light, sound and aroma care at the right time, for a suitable period of time, and with the required intensity as well as quality. Further unique selling points: (a) a modular and extensible system, where modules (light, sound, aroma) can be easily added or removed without incurring any additional installation effort, (b) the scalability and flexibility may be adapted to changing user needs in line with the progress of dementia, (c) valuable information about the dementia patients for caretakers and physicians based on data collected by sensors, and (c) easy handling of system with just 2 buttons (activation vs. relaxation).

1 Product requirements

1.1 Dementia

The term dementia refers to a clinical syndrome. Neurodegenerative and vascular forms of dementia are based on diseases of the brain that are considered to be steadily progressive and incurable. Dementia diseases are defined by the reduction and loss of cognitive functions and everyday skills. In addition to cognitive symptoms, patients with dementia diseases also exhibit a number of behavioural and psychological symptoms of dementia (BPSD). BPSD include delusions, hallucinations, agitation, depression, anxiety, euphoria, apathy, disinhibition, irritability, abnormal motor behaviour, sleep disorders, appetite and eating disorders.

All the above symptoms are assessed with the Neuropsychiatric Inventory (NPI). The NPI has now become the most widely used to measure these symptoms in clinical trials in dementia. In most cases, clinical studies indicate a change in the overall score. In some studies, information on effects on individual symptoms is found. Psychopharmacological therapies with antidementia drugs, antidepressants, anticonvulsants, antipsychotics and benzodiazepines/hypnotics but also light therapy, music therapy and aromatherapy show partial improvements in the NPI.[1]

In dealing with people with dementia, the nursing staff faces additional challenges. They experience BPSD as particularly stressful. The stress can lead to health problems for caregivers, such as somatic complaints and psychological impairments, and as a consequence can influence their behaviour towards dementia patients. The subjective perception of stress and strain can be influenced by the company health management and the adequate handling of challenging behaviour of people with dementia. The "Professional Care Team Burden" (PCTB) scale is often used to measure the subjective perception of stress and strain.

1.2 Daily structuring

People with dementia can focus their attention on a particular stimulus, but as the dementia progresses it becomes increasingly difficult for them to focus attention on new or changing environmental stimuli. The loss of spatial and temporal orientation with dementia contributes to BPSD. In order to get people with dementia to perform a certain action and thereby maintain their daily structure (e.g. getting up, coming to eat, going to bed), they must be prepared for the activity early. In addition to adequate communication, an appropriate design of the environment also contributes to this.

[1] Savaskan, E. et al. (2014). Therapy Guidelines for the Behavioural and Psychological Symptoms of Dementia. Praxis, 103(3), 135-148.

Human performance shows typical day-periodic fluctuations, which are not only but also most strongly influenced by the day-night rhythm. Regular activation and relaxation by the vegetative nervous system forms an important basis for time orientation throughout the day. A repeated change between active phases and rest phases finally forms the day structure. For people with dementia it is also important to maintain a constant daily structure, which is oriented to their usual daily rhythm.

In addition to social timers (e.g. the daily schedule), other regularly recurring environmental stimuli are also important for structuring the day. The best known is circadian lighting, which is based on natural sunlight. But essential oils also have an effect on restlessness and sleep behaviour. And music or sounds lead to the activation of structures that are important for alertness and attention. Finally, the above-mentioned interrelationships form the basis for some approaches from the fields of light, sound and aroma therapy resp. care.

1.3 Light, sound and aroma care

Light care influences, among other things, the release of melatonin and, above all, the circadian rhythm. A narrow frequency band in the blue light range of white light (wavelengths 446-477 nm) should be physiologically effective. Sound care should be able to influence vegetative rhythmic patterns and is used in receptive form mainly for relaxation. Aroma care can have a direct effect on the organs. Lavender oil, for example, should have a relaxation effect, thyme activating, jasmine oil strongly spasmolytic, sedative, antidepressant, orange and lemon oil should lighten the mood.

The surveys and workshops at the beginning of this project showed that light, sound and aroma care is very often used for people with dementia. All of the facilities that took part in the field study either used one or more of these care methods or already had experience with them. The observations on site and in other facilities showed, however, that their use is not always systematic or according to a specific care plan. This applies to the timing, frequency and type of intervention. In most cases, it was not technically possible to vary the timing, frequency and type of intervention systematically.

Thus, a need for the systematic use of light, sound and aroma care, based on a healthy daily structure in people with dementia, can be identified. The market analysis has shown that currently available products for light, sound and aroma care only partially meet the required specifications. A product that includes all three modules (light, aroma and sound) and which can be used specifically for elderly people with dementia is currently not available on the market.

2 Product development

The product development was based on the experience and already existing concepts of the project partners. In a user-centered development process, the hardware and software of the GREAT modules for light, aroma and sound were iteratively produced as a prototype at Technology Readiness Level TLR8 (for aroma as well as sound) and TLR9 (for light). The following table shows how the end users were involved.

Table 1: User participation plan.

Consolidation and integration	Specific needs of PwD analysis	**28** participants in focus groups and **4** expert interviews
	Workshop A: define goals and identify acceptability concerns	AAL acceptance analysis with **17** end-users.
Implementing Self-learning Persuasive Room Ambience	Medical and psychological implications (iterated)	**7** Expert interviews with care givers from all care facilities involved.
	Workshop impact measurement (DCM) FHS – Switzerland	**15** participants / secondary end-users
	Technological integration (iterated): Integrate all target groups with participatory design.	User sessions with **24** end-users.
	Workshop B: identify accessibility issues and improvement potential	Usability and User-Experience assessment with **13** end-users.
	Pilot application: functionality and acceptance evaluation	Test runs with **31** end-users in different countries and **4** scenarios.
Impact Assessment	Lab-Pretest with healthy subjects	Effect testing on **1836** single persons in systematic laboratory experiments.
	Pretest with healthy subjects	Testing on **321** people in several group situations.
	Field testing in different countries: testing of the GREAT system over a period of 19 months	Austria: Common room scenario with **82** PwD and **16** caregivers (56 records). **8** assisted living apartments (16 records) with **6** caregivers.
		Switzerland: **19** end-users took part in **3** nursing homes (59 records). **1** private installation.
		Italy: Common room scenario with **20** PwD (65 records) and **17** caregivers (58 records).
	GREAT-Interventions: activation and relaxation with light, sound, and scent	**3347** interventions on PwD
Market development	Questionnaires for evaluating acceptance	**431** secondary end-users for evaluating improvements of each module
	Workshop C: Economically oriented end-user investigation	Addressing questions to affordability and valuation of the solution, willingness to use it and willingness to pay for it (price sensitivity) with **22** end-users.

2.1 Hardware components

The hardware of the GREAT system mainly consists of the output modules for light, aroma and sound, the measurement sensors for motion and pulse rate detection as well as the central control unit and the front-end user interface. The fragrance module can specifically dispense two different essential organic fragrance oils. In contrast to evaporation devices (passive or active

with ultrasound and heat), our device emits the fragrance only with the switching impulse. The switching impulse is supplied by the central control unit. The device has integrated sensors for measuring air quality (VOC), air humidity, air temperature and air pressure as well as a level measurement.

Figure 1: Output modules for light, aroma and sound.

The sound module consists of stereo loudspeakers, which are also able to play ultrasound. In the current version, the module loads the sounds from the Internet and stores them internally. The sound module receives instructions from the central control unit as to which sounds are to be played when and from where the sounds are to be downloaded. The light module is available as floor, pendant and wall light. The module can produce different intensities and colour temperatures via both direct and indirect lighting. The light module receives instructions from the central control unit as to which intensity and colour temperature should be generated directly or indirectly.

Figure 2: Measuring sensors for motion and pulse rate detection.

In addition to the sensors in the fragrance module, the GREAT system consists of two external measuring devices as standard. A motion detector, which is usually mounted on the ceiling of the room, detects all movements in the room. It is a passive infrared detector that continuously indicates whether there is any movement in the room or not (binary signal). The motion detector also has an integrated brightness sensor. The device for detecting the pulse beat frequency is a device that was not developed within the project. It is the Everion remote monitoring solution from Biovotion with its own external controller.

Figure 3: Central control unit and front end user interface.

The central control unit of the GREAT system contains the control curves for the light, aroma and sound module(s) as well as the software for the automatic mode (see next chapter). This is also where all measurement data converge, which is only temporarily stored here and then forwarded to the backend. Communication with the back end is via LAN, radio communication with the light module and the motion sensor is via EnOcean and radio communication with the aroma and sound module and the heart rate monitor is via WLAN.
End users have three different options for controlling the GREAT system and thus the activation and relaxation intervention:

- manual triggering with a graphical user interface
- time-controlled triggering according to a defined intervention plan
- automated triggering

For the manual control of all modules a graphical user interface is available, which can be called up with any web browser. Thus, an activation or relaxation intervention can be started (and also aborted early) for each

individual module or for all modules together. The time-controlled and automated triggering is described in the following chapter.

2.2 Software components

The backend of the GREAT system essentially consists of a configuration tool and a software for data management. Both applications are designed as cloud solutions and have an authorization concept for different users. From the perspective of software architecture, the software on the central control unit is between the two of them. The configuration tool defines the settings for all modules of GREAT. If the GREAT system is operated manually via a graphical user interface, the configuration defines which light, aroma and sound stimuli are output in case of an activation and relaxation intervention. If the GREAT system is used with time-controlled logic, the configuration tool is used to define the intervention plan (e.g. care plan).

Figure 4: Backend user interface for configuration by service provider.

The backend data management software receives all measurement data from the controller of the GREAT systems via LAN and manages them on a secure server. This data management is especially necessary when the GREAT system is operated in automatic mode. The logic for the automated triggering is currently based exclusively on the acquired motion data.

For such an application, an average 24h profile is first formed over all previous days (until the start of measurement). A low-pass filter with finite impulse response (FIR low-pass to remove strong fluctuations in motion activity) is applied to this profile. This corresponds to a moving average with centering. By stretching and compressing the time series thus obtained in the y-direction, the regular range for allowed deviations of a currently measured motion activity from the moving average is defined.

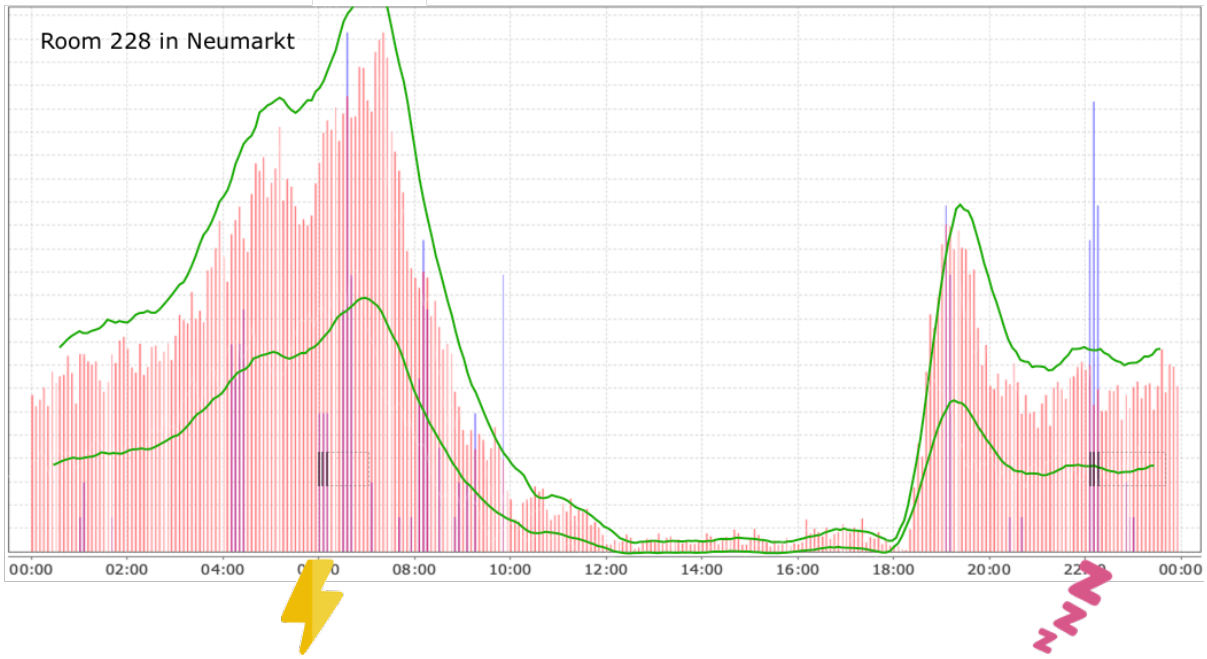


Figure 5: The red lines show the average 24h profile calculated from all measurements (of room 228 in Neumarkt) since the start of operation. The blue lines show the motion measurement in room 228 for a single day. The green lines show the regular range generated by a low pass filter and by compression and expansion of the average 24h profile. The lightning icon indicates where the GREAT system automatically starts an activation intervention and the ZZZ icon indicates where the GREAT system automatically starts a relaxation intervention.

The example in figure 5 shows the data in the automatic mode of the GREAT system for a room with the beds of two dementia patients and a bathroom. In the morning the control system identified an activation intervention and in the evening a relaxation intervention. Both automatically generated interventions make sense in this case, since patients get up at 6 a.m. in the morning and in the evening there is actually rest time before 10 p.m.

3 Product evaluation

The GREAT system allows two interventions: a relaxation of the situation and an activation in a situation with the help of light, aroma and sound. This should counteract behavioural and psychological symptoms of dementia (aim: less pronounced neuropsychiatric symptoms). The GREAT intervention should, in the case of relaxation, cause a reduction in movement activity in the room in which the GREAT system was installed. In the case of activation, an increase in movement activity in the room.

As a result, caregivers should find it easier to provide care, which should be reflected in adequate vegetative activity (relaxation or activation) and a subjectively perceived lower level of stress (aim: lower PCTB score). In the field study, we also wanted to determine whether the nursing staff are able to assess the effect of the GREAT system themselves.

Pretest: Prior to the start of the field study with dementia patients, the GREAT system was tested on healthy persons. In total, the effect was tested on 1836 persons in systematic laboratory experiments. Because the system is used in different situations, it was tested on people of different ages. In addition, the spontaneous impressions of a total of 321 people were collected in group situations.

In the field study, the GREAT system was used for a total of 19 months in five facilities for people with dementia, one facility with assisted living for senior citizens and one private apartment. The field study included a total of 130 elderly people with dementia and 39 nursing staff. The dementia patients in the facilities participated in the field study for varying lengths of time. For them, a study phase with light, aroma or sound intervention or with a combination of light, aroma and sound as intervention lasted between two weeks and six months. Some dementia patients participated in several study phases. These included those observed over the entire 19-month period.

3.1 Physical activity

The movement activity in the room was recorded with a motion sensor placed on the ceiling. For all 3347 GREAT interventions carried out in the project, an average value of physical activity was calculated before the intervention, during the first and second half of the intervention and after the intervention. After a plausibility check, 1905 cases were included in the further evaluation. In addition, mean values were calculated in the same way for 482 random observation periods with the same times of day at which no GREAT intervention took place. After a plausibility check, 171 cases were included in the further evaluation.

The course of the selected parameter "IntegralMotion" for motion activity is similar in these three situations, and yet a visual inspection reveals differences

(see Figure 6). The initial situation was more unsettled in the case of the relaxation intervention than in the activation intervention. Conversely, after the end of the intervention, motor activity was significantly lower in the relaxation intervention than in the activation intervention. Both results may indicate an influence of the GREAT system that was intended.

The Wilcoxon sign rank test (a nonparametric statistical test) for comparing mean values of pre and post-intervention exercise activity shows a significant difference in both GREAT interventions (p=0.001 and p <0.001).

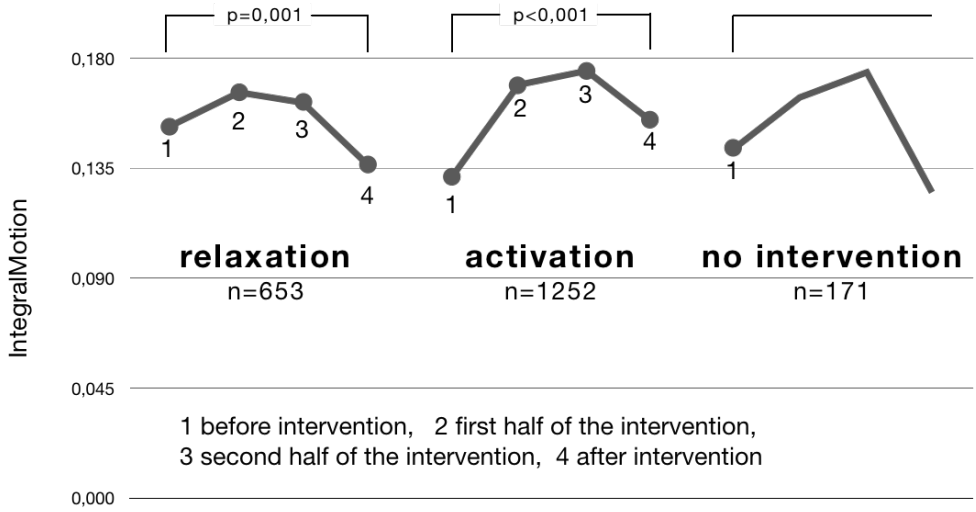


Figure 6: Physical activity before, during and after GREAT interventions (total).

Comparing the physical activity in the space before and after the GREAT intervention for the different types of relaxation and activation intervention, the result in Figure 7 emerges. A bar shows here the mean value before the intervention on the left half and the mean value after the intervention on the right half. For the statistical comparison of the two mean values, a t-test for paired samples was performed. This shows a statistically significant difference ($p<0.05$) for the combined application of light, aroma and sound in the case of relaxation and for the separate application of light, aroma and sound in the case of activation. In the case of relaxation, the movement activity after the procedure was lower and in the case of activation, higher in all three cases. This again indicates an intended influence of the GREAT-System.

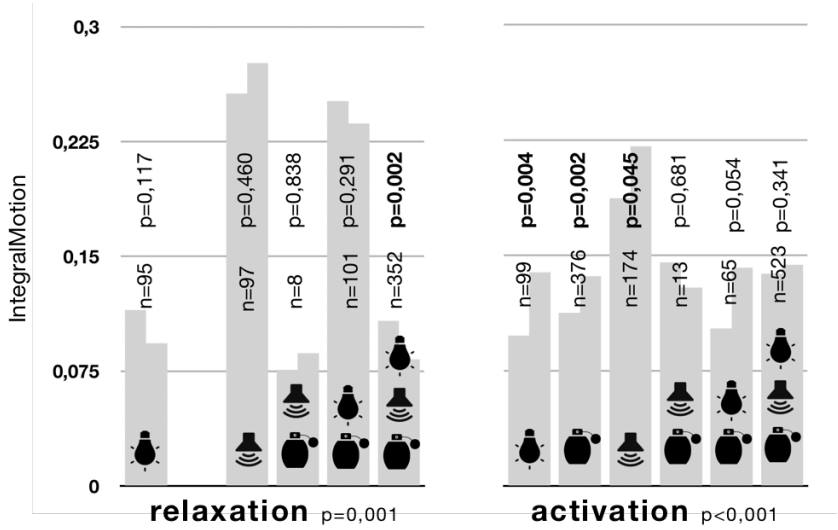


Figure 7: Physical activity before and after various GREAT interventions.

3.2 Neuropsychiatric symptoms

In total, more than 130 elderly people with dementia symptoms were observed over varying periods of time in this study. During this observation period they received different treatments. More than half of them also used the GREAT system. At the beginning and end of the observation period, the dementia symptoms were described using the Neuropsychiatric Inventory (NPI). The NPI describes several behavioural abnormalities and displays values on a scale from 0 to 144.

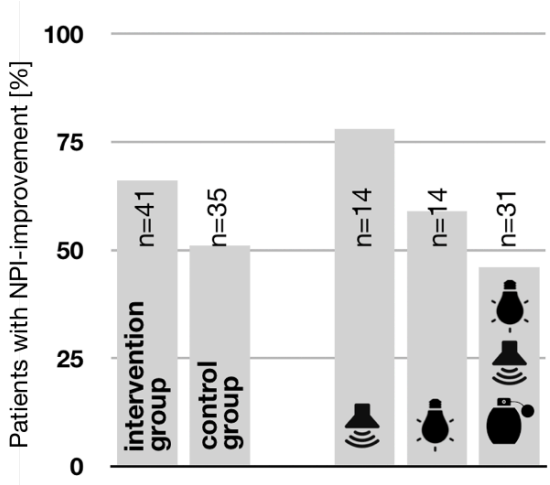


Figure 8: Improvement of neuropsychiatric symptoms.

We have such NPI data sets from 41 patients with the GREAT System and 35 patients without the GREAT System (in AT und IT). In the intervention group, 66% of the individuals showed an improvement in neuropsychiatric symptoms, while in the control group only 51% showed an improvement in neuropsychiatric symptoms. Within the observation period, overall NPI improvement of more than 21 points was documented. Looking at the result for different interventions of the GREAT system in Figure 8, the application of sound showed an improvement in 78% of cases, light in 59% of cases and the combined application of light, aroma and sound showed only in 46% of cases an improvement in neuropsychiatric symptoms.

3.3 Vegetative activity

The nursing staff at the test sites were free to decide whether they wear the bracelet to record heartbeats on specific days. 24 nurses wore the bracelet on a total of 121 days. For the vital signs data collected in this way, a mean value of the pulse rate before the intervention, during the first and second half of the intervention and after the intervention was calculated and plotted in Figure 9.

The two curves in Figure 9 show a totally different picture. In the case of the relaxation intervention, the pulse rate has the highest mean value in the observation period with over 89 BPM before the intervention. During the intervention, it drops to a value below 87 BPM. In the case of the activation intervention, the pulse rate has the lowest mean value in the observation period with almost 86 BPM before the intervention. It rises to a value above 87 BPM until after the intervention.

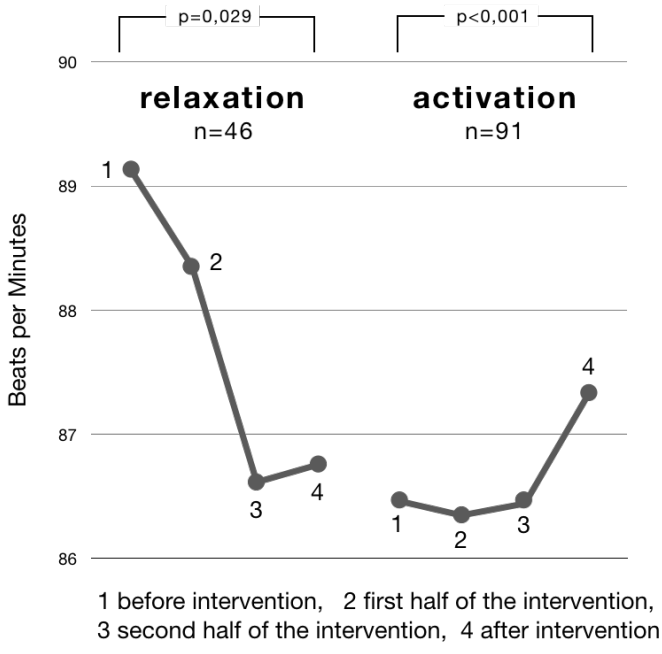


Figure 9: Vegetative activity before, during and after GREAT interventions (total.

Despite the small absolute differences, the statistical comparison of the mean values before and after the intervention using the paired sample t-test shows a statistically significant difference in both cases ($p=0.029$ and $p<0.001$). Both again indicate an intended influence of the GREAT system.

3.4 Assessment of subjective stress

In total, 39 people were repeatedly asked about their subjective burden of caring for people with dementia over a longer period of time. The evaluation was carried out using the "Professional Care Team Burden" (PCTB) scale, which gives an overall score of 0 to 40. In AT and IT we have data sets of 17 people who performed their activities using the GREAT system and 17 people who performed their activities without the GREAT system.

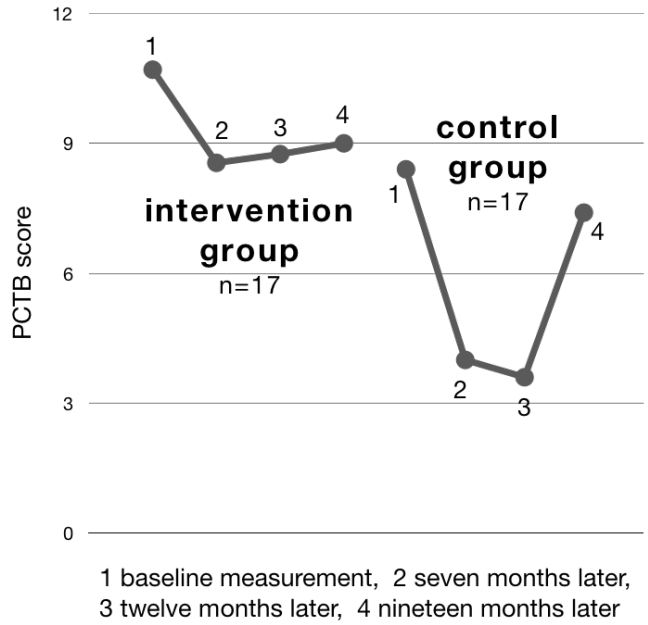


Figure 10: Assessment of subjective burden of caregivers.

Figure 10 shows that both the intervention group and the control group subjectively estimate their own burden to be lower after the baseline survey. One may assume a so-called Hawthorne effect, in which individuals change their opinion or behaviour because they receive more attention. In contrast to the control group, however, the intervention group has the feeling that its burden remains at a similarly low level even without increased attention (in phase 4).

3.5 Subjective effect evaluation

After a GREAT intervention, nurses were able to evaluate the effectiveness of the intervention from their subjective viewpoint on a four-point scale. With a score of 1, they expressed that in their opinion the intervention achieved the intended effect. With a score of 4, they expressed that they could not see any effect. A total of 307 such evaluations were carried out.

Figure 11 shows the mean assessment values for the different types of relaxation and activation intervention. If all cases with less than 30 judgments are omitted, the separate sound and aroma intervention receives an average good rating from the nursing staff. The separate light intervention and the combination of light, aroma and sound as an intervention were rated worse by the nursing staff.

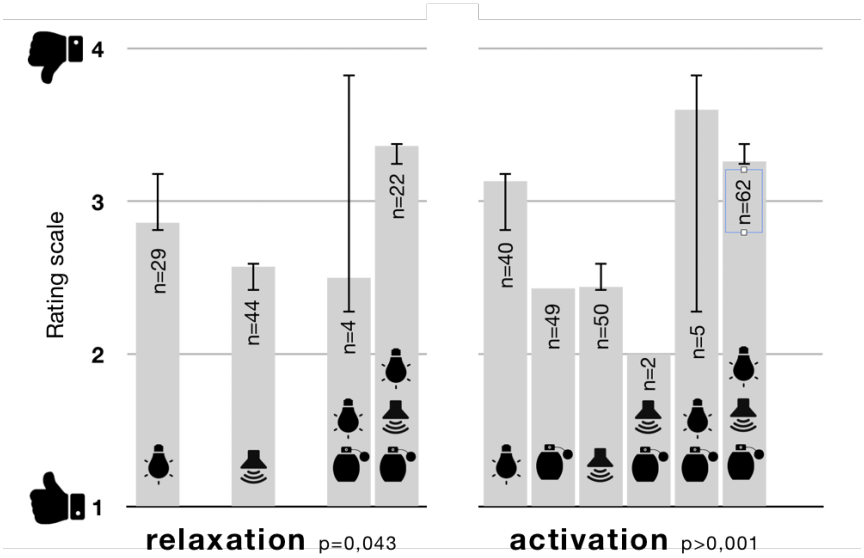


Figure 11: Subjective evaluation of the effectiveness of GREAT interventions.

It should be noted that this was a subjective evaluation in the daily work of the carers without training in behavioural assessment and that the judgements were sometimes made with a long delay after the intervention.

4 Product marketing

4.1 Market analysis

For each GREAT module, a market analysis was conducted to identify competitors and compare the key product specifications. Figure 12 shows the advantageous product characteristics of GREAT modules compared to competitors. Comparable products only partly show these specifications or they were more expensive. A product that includes all three modules (light, aroma and sound) in the sense of the overall GREAT system and can be used specifically for elderly people with dementia is not available on the current market. Therefore, the GREAT system has a unique position on the market.

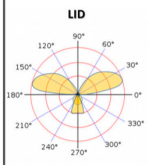
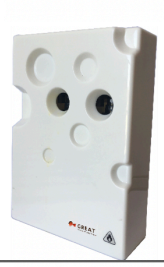
	purcha-sable: Barten-bach or emt	appli-cation for care facilities, esp. for people with dementia	luninous flux: 150W, 10500 lm; color rendering index > 90	color tem-perature: 2200-5000K (melatonin light)		wireless control via EnOcean and Casambi	€2500
	purcha-sable: FH Vorarlberg	appli-cation for care facilities, esp. for people with dementia	freely program-mable according to care plan	dispen-sing technics: nebulizer (targeted)	freely selectable natural essential oil in organic quality	two different fragrance s specificall y controllab le	€250
	purcha-sable: FH Vorarlberg	appli-cation for care facilities esp. for people with dementia	freely selectable sound from a playlist	plays internal files with 80 kHz (ultra-sonic)	customi-zable playlist; combinable with music streaming services	synching with smartpho ne and WLAN (inkl. smart home)	€200

Figure12: Favourable product characteristics compared to competitors.

4.2 Business model

The Business Model Canvas was used to develop and document the business model for GREAT. The following figure shows the result in the usual way. For the price calculation, the detailed costs were also determined and a revenue forecast was created. All in all this results in a promising business model for the GREAT system.

GREAT Business Model

Key Partners

Hardware Partner: luminaires from Bartenbach or emt, controller and sensors from Intefox, scent module from FHV, loudspeaker from external manufacturer.
Software Partner: Intefox is responsible for software with support from FHV
Marketing: B2B by Bartenbach and emt; B2B2C via end-user organisations and distributers
End-User Organizations: contacts with customers via Curaviva, ASG, TKH, SGG, Curena, mobile care organisations, IBH AAL Living Lab
CRM contacts: smarterion, ProAir, and Primavera help to distribute the product
AAL planners & consultants: provide knowledge and experience (all partners)
Customer Support Service: Single Point of Contact per nation

Key Activities

R&D & Design: further development and harmonising design;
Planning & Installation: either the in-house IT department or an external contractor (plug&play)
Marketing & Branding: we use Bartenbach, emt and Intefox brand; marketed B2B, B2B2C, and online (B2C)
Support: hotline for residential and nursing homes; on-site service, post-purchase support

Key Resources

Knowledge: knowledge about dementia (TKH, dementia experts at FHG and FHV), effects of light, sound and scent (reserach partners), machine learning (FHG), home automation (Intefox)
CRM: network of end-user organizations (e.g. CURAVIVA), Aktion Demenz (AT), IBH Living Lab AAL, architects, light planners, aroma and music therapists

Value Propositions

Enhance Quality of Life:
(a) measure against agitation and depression; improved life-style; enable autonomy for PwD and independent living for elderly;
(b) measure to reducing stress and the burden of care for caregivers
Customization: room ambience system fitting to individual requirements and/or systematically controlled in line with therapy plans
Intelligence: self-learning software for intelligent & unobtrusive support of daily routines (experimental during test phase)
Service: easy maintenance & support
Modular and Extensible: output modules (light, sound, scent) as well sensors (motion activity, pulse rate) can be easily added or removed

Customer Relationships

General contractor: only 1 contact person, organisation or company who manages everything and provides a a bundle of services
Services: configuration, support, updates, maintenance

Channels

Partners: sales partners, architects, lighting planners
Affiliate partners: e.g. Med-Innova or online channels
Post-purchase support: direct phone or in-platform support
Demonstration Facilities: e.g. exhibitions, virtual showrooms
Online channels, e.g. puras.ch, smartliberty.ch, medicur.ch
Platforms e.g. iCare Coops, Alter & Technik, CuraSolutions

Customer Segments

People with dementia: PwD in early stages living at home and needing support for structuring their day, residential patients in care facilities
Caregivers: informal/family care-givers in residential settings who want to ease their burden;
carers in care facilities who are responsible for many PwD at once and like the support of an unobtrusive system
Care facilities: specialized in dementia patients and nursing homes in general;
anyone who can benefit from a systematic control of room ambience parameters (light, sound, scent), e.g. health organisations, wellness;
anyone who can benefit from human-centric lighting, e.g. people working night-shifts, workers engaged in repetitive tasks, etc.

Cost Structure

Hardware Costs: components, e.g. luminaires, sound modules, scent dispensers
Marketing and Branding: costs for successful marketing
Support: maintenance and service depending on business model
Software Licences: costs for software licence from Intefox, if necessary
Personnel: depending on business model
R&D Costs: costs for improving the system and/or certifying components

a detailed cost calculation is available

Revenue Streams

System Sales: product is sold as a package (planning, installation & hardware included); different expandable packages can be chosen; there is a tailored solution for private homes and a solution for care facilities which are both modular and scalable;
Service Revenues: revenues from additional support and recurring revenues from leased systems
Consulting: additional revenues can be achieved from consulting end-user organisations
New Modules: Sales can be increased by adding new modules to the system later on

4.3 Dissemination

The project members have contributed through various communication channels to the dissemination of the new approach of GREAT and the results of the project. The following results can be presented:

Talks for different target groups: 35
Exhibitions with the demo booth (see picture): 5
Project folder: 5
Articles: 8
Poster presentation: 5
Workshop and Round Table: 11
Video trailer: 2
Websites presence: 6
Press releases: 7
Website: http://great.labs.fhv.at

Figure13: Dissemination examples: talk in Bolzano (IT) and demonstration in Bilbao (ES).

Selected papers:

Pallauf, M., Hämmerle, I., Kofler, M., Förster, K., Werner, T., & Kathrein, J. (2019). Assistenztechnologien im Wohnraum älterer Menschen - Erwartungen und Akzeptanz. Umweltpsychologie, 23/1, 10 - 33.

Piazolo, F., Kempter, G. & Promberger, K. (Hrsg.). (2019). Innovative Solutions for an ageing Society. Lengerich: Pabst Science Publisher.

Trommelschläger, K., Künz, A., & Ritter, W. (2019). Developing user centered technological prototypes to maintain physical health. In F. Piazolo, G. Kempter, & K. Promberger (Hrsg.), Innovative solutions for an ageing society, p. 81 - 92. Lengerich: Pabst Science Publishers.

Werner, T., Trommelschläger, K., & Hohpe, S. (2019). Studie zur kombinierten Wirkung von Licht, Geruch und (Ultra-)Schall. In P. Friedrich & D. Fuchs (Hrsg.), Assistive Technik für selbstbestimmtes Wohnen, S. 9 – 14. Cuvillier Verlag.

Werner, T., Trommelschläger, K., & Jost, P. (2019). Creating activating and relaxing atmospheres using light, scent and sound. In F. Piazolo, G. Kempter, & K. Promberger (Hrsg.), Innovative solutions for an ageing society, p. 148 - 157. Lengerich: Pabst Science Publishers.

5 Conclusion

The GREAT system showed the intended effect in some aspects of its field of application (which, however, could not be perceived by the nursing staff accordingly). The activity in the room with dementia patients was significantly lower after the relaxation intervention and significantly higher after activation intervention than before the intervention. In the initial situation (i.e. before the GREAT intervention was initiated) the activity in the room was also higher in the case of a relaxation intervention than in the case of an activation intervention. The same unambiguous picture emerges when analysing the vegetative activity of caregivers (pulse rate).

Looking at the neuropsychiatric symptoms of dementia patients (NPI), the picture is less clear. Although 66% of the dementia patients in the intervention group showed an improvement in neuropsychiatric symptoms after using the GREAT system, only 51% in the control group did so during the same observation period (both groups also received conventional medical treatment). However, it must be noted that over a longer period of time (in our case 19 months) the negative course of the neurodegenerative disease could not be stopped.

It is equally ambiguous about the subjective self-assessment of the burden on caregivers. After half a year, both the intervention group (using the GREAT system) and the control group of nurses estimated their own burden of caring for dementia patients as lower. However, after one year the control group indicated that their burden had returned to the original level, while in the intervention group the self-assessment remained at the improved level.

The differentiated evaluation of the individual GREAT interventions (light, aroma, sound and their combinations) in the field study is again based on objective measurement data. Looking at the data on movement activity, it appears that the separate use of light, aroma and sound particularly supports activation, while the combined use of light, aroma and sound particularly supports relaxation. Interestingly, caregivers rate the combination of light, aroma and sound worse than the separate use of light, aroma and sound.

We therefore conclude that the GREAT system can be used to influence the behavioural and psychological symptoms of dementia (BPSD). Not only in the pre-test but also in the field study, evidence for the selective relaxation and activating effect of light, sound and aroma could be provided. As the concluding focus group discussion showed, before the GREAT system can be commercialized, it must still be ensured that the observed initial difficulties in introducing the system (e.g. care plan, control) have been overcome.