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Effects of Enriched Thematic Multi-Sensory Stimulation on BPSD in A Beach Room: A Pilot Study among Nursing-Home Residents with Dementia

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Abstract

***Background*:** Studies conducted on the effectiveness of psychosocial interventions have indicated that sensory stimulation represents a promising approach to reduce the psychological and behavioral disturbances in people with dementia. Multi-sensory stimulation involves the simultaneous stimulation of multiple senses, through the use of various methods, for example, by using a variety of lights, gentle stimulating music, aromas,

and tactile objects, among others. A relatively novel approach is the enriched thematic multi-sensory stimulation, which involves the simultaneous stimulation of multiple senses using stimuli that are related to positive themes. The objective of the present pilot study was to explore the effects of enriched thematic multi-sensory stimulation on the behavioral and psychological symptoms in people with dementia (BPSD) among psychogeriatric nursing-home wards.

***Methods*:** A pilot study designed as a randomized controlled trial was conducted with repeated measurements and two conditions: (1) the experimental condition that involved enriched multi-sensory stimulation in a thematic Beach Room; and (2) the control condition that involved visits to the nursing home's standard Grand Café room without enriched multi-sensory stimulation. A total of 49 nursing-home residents, who were assigned randomly to one of the two conditions, participated in the present study three times a week for 30 min for a duration of 12 weeks. Outcomes were measured at three time points. The primary outcomes – depression, agitation, and apathy – were measured using the MDS-Depression Rating Scale and Cornell Scale for depression in dementia, the Cohen-Mansfield Agitation Inventory, and the Apathy Evaluation Scale, respectively. The secondary outcomes – sleep–wake patterns, observed behavior, and mood – were measured using the Actiwatch activity monitor, the INTERACT observation scale, and the FACE observation scale, respectively. Multi-level repeated-measures analyses were performed.

***Results*:** A total of 49 nursing-home residents with dementia participated in the present study, among which, 35 residents completed the follow-up – 18 residents in the Beach Room and 17 in the Grand Café environment. Sleep improvement was observed among the residents who visited the Grand Café environment. These residents also exhibited fewer feelings of depression. No improvements in the selected primary and secondary outcome measures were observed among the residents who visited the Beach Room.

***Conclusions*:** Enriched multi-sensory stimulation does not necessarily exhibit higher effectiveness in reducing psychological and behavioral symptoms among the nursing-home residents with dementia in comparison to stimulation within a less enriched environment. The present pilot study demonstrated that the control condition consisting of a Grand Café environment, which included extra daylight, exhibited higher effectiveness. Future research should attempt to unravel the elements and working mechanisms that provide effectiveness.

Keywords

Dementia; multi-sensory stimulation; behavioral and psychological symptoms; sleep; nursing homes

1. Introduction

Psychological and behavioral disturbances, such as depressive feelings, agitation, apathy, and sleep–wake disturbances, represent a severe burden for several people suffering from dementia as well as their caregivers [1, 2]. Scientific studies have demonstrated that pharmacological interventions are often not much effective in reducing these disturbances, and may instead result

in negative side effects, such as the increased risk of falling or accelerated cognitive decline [3]. Strong hopes have, therefore, been attached to psychosocial interventions [4].

Studies conducted on the effectiveness of psychosocial interventions have indicated that sensory stimulation represents a promising approach to reduce psychological and behavioral disturbances in people with dementia [5-9]. Multi-sensory stimulation involves the simultaneous stimulation of multiple senses, through the use of, for example, a variety of lights, gentle stimulating music, aromas, and tactile objects [10]. Traditionally, multi-sensory stimulation is offered in a multi-sensory room, also referred to as Snoezelen room. In this room, an array of equipment is installed, which offers multiple stimulations (i.e., aroma steamers, music, etc.) involving several sensory channels [11].

Limited evidence is available for the effectiveness of multi-sensory stimulation on behavioral and psychological disturbances in people with dementia. Recently, Larusso et al. [8] reported a systematic review of the impact of multi-sensory environments on the behavioral and psychological symptoms of dementia (BPSD), which included twelve relevant studies. These studies were mostly those which investigated and compared one-to-one interventions within a multi-sensory-room with other one-to-one activities, such as playing cards, quizzes, or watching photographs. The authors concluded that while multi-sensory stimulation was effective in reducing BPSD on a short-term basis (during or immediately after the intervention), it did not exhibit higher effectiveness compared to the other one-to-one activities. In a recent study that compared the effects of individual multi-sensory stimulation within a Snoezelen room with individualized music sessions on elderly people with severe dementia, Sánchez et al. [9] suggested that multi-sensory stimulation and music exerted comparable effects on the measures of agitation and mood after 16 weeks of intervention, while the multisensory stimulation in a Snoezelen room presented better effects on the measures of anxiety and dementia severity in comparison to the music intervention. On the basis of their review, Larusso et al. [8] provided a few recommendations for future research and interventions in this area. First, they advised conducting further research on the role of participants' sensory preferences on the effectiveness of multi-sensory stimulation. Second, they advised to develop interactions that did not necessarily involve staff, such as those between different groups of patients, patients and volunteers, or patients and their family members, as these types of (group) interventions are more congruent with staff-to-patient ratios within the assisted living situations.

A relatively novel approach, partly based on multi-sensory stimulation and preferences of the patients, is the thematic multi-sensory stimulation. Thematic multi-sensory stimulation involves the simultaneous stimulation of multiple senses through the use of stimuli that are related to positive themes that could possibly arouse positive feelings and memories in patients. The assumed working mechanisms underlying the effect of thematic multi-sensory stimulation on psychological and behavioral symptoms are as follows: The development of behavioral problems in people with dementia has been associated with a reduction in positive experiences and in brain activity, which might be caused directly (brain damage) or indirectly (psychosocial aspects) by the dementia. Preferred stimuli activate the memories of positive events that happened earlier in the lives of patients with dementia [12]. Since positive memories are preserved better than the neutral memories, and are, therefore, activated relatively easily, and because the activation of positive memories generates positive experiences, multi-sensory stimulation with preferred stimuli is expected to provide higher effectiveness in reducing the behavioral problems compared

to the multi-sensory stimulation with neutral stimuli. Neurobiological studies further raise the expectation that multi-sensory stimulation exerts a positive influence on both behavioral problems and sleep-wake cycles in people with dementia. A few researchers assume that sleep-wake cycles could even play an intermediary role in the reduction of behavioral problems [7].

Thematic multi-sensory stimulation is, therefore, based on the following assumptions: a) stimuli are able to reinforce each other if they are thematically related; b) arousing positive memories exerts a positive effect on the behavior of people with dementia [13].

The study conducted by Goto and colleagues suggested that thematic multi-sensory stimulation might indeed lead to improvements in psychological and behavioral outcomes [14, 15]. In their study, a Japanese garden room was compared with stimuli in a Snoezelen room. The subjects who visited the Japanese garden room exhibited reduced stress levels and positive behavioral changes, which were observed to be either absent or present to a very limited extent in the subjects who visited the Snoezelen room [14]. One of the characteristics of Japanese gardens is that they are designed to occupy a small space and may be viewed from the living area. The Japanese garden in the study conducted by Goto et al. was a temporary indoor Japanese garden within a nursing home. The design of the garden represented a typical tea garden comprising stones (visual), plants (visual and olfactory), a water basin (sound and olfactory), a stone lantern (light), and a bamboo fence (visual). The fragrance of chrysanthemum was noticeable in the room [14, 15]. Goto et al. [15] explained the positive effects of the Japanese garden through a combination of factors: (1) the landscape of the Japanese garden induced the viewers to scan a wide area, increased their alertness, and decreased their physiological stress, compared to viewing a control unstructured garden space; (2) several subjects stated having pleasant memory associations with nature; (3) the fragrance of chrysanthemum from the garden lowered the average heart rate.

The objective of the present study was to further explore the effects of enriched thematic multi-sensory group stimulation on the behavioral and psychological symptoms (depression, agitation, apathy, and sleep disturbances) in people with dementia. It was hypothesized that when a greater number of senses are stimulated simultaneously around a positive theme (enriched thematic multi-sensory stimulation), a greater positive impact on the behavioral and psychological symptoms occurs. The experimental thematic multi-sensory condition comprised a room in which a beach environment was simulated. The 'beach' theme was selected because it offers the opportunity to stimulate various senses, and is, in Dutch people, often associated with positive memories. The Beach Room stimulated senses through tactile, visual, auditory, olfactory, and taste stimuli. The control condition was a social café type condition. The following research questions were formulated:

1) Does enriched thematic multi-sensory group stimulation in a beach environment reduce the symptoms of depression, agitation, and apathy among the nursing home residents with dementia in comparison to the non-enriched stimulation in a social café type condition?

2) Does enriched thematic multi-sensory stimulation in a beach environment improve sleep-wake cycles, observed behavior, and mood among the nursing-home residents with dementia in comparison to a non-enriched stimulation in a social café type condition?

2. Materials and Methods

2.1 Study Design

The present study was designed as a pilot randomized controlled trial (RCT) conducted with repeated measurements and the following two conditions: (1) enriched multi-sensory group stimulation in a thematic Beach Room; (2) visiting the nursing-home's standard Grand Café room, without the enriched multi-sensory stimulation.

2.2 Population

The present study was conducted in a nursing home in the Netherlands in two comparable wards for people with dementia. All the residents with dementia who had been residing in one of the two wards for at least one month were eligible for inclusion in the present study. A total of 40 residents (20 in the Beach Room group and 20 in the Grand Café group) were considered suitable for the pilot character of the study.

2.3 Experimental and Control Conditions

The experimental 'Beach Room' condition comprised a room in which a beach environment was simulated. The Beach Room stimulated the senses by including the following: sand, heat, and a breeze (tactile); sunlight and beach scenery (visual); beach and sea sounds (auditory); the smell of the sea (olfactory); and non-alcoholic drinks (taste). Sunlight was simulated by using the Suntech Trippel Lamp [luminous intensity: 12,000–25,000 lux; luminous spectrum: 315 nm–2000 nm; sunlight power/m^2: 400–500 W/m^2] (www.suntechgroup.se). Groups of three to five residents were allowed to sit together in the condition, along with a nurse or occupational therapist. The environment encouraged these residents to interact with each other (e.g., to talk regarding the beach and the sea sounds or to throw a beach ball). These thematic interactions were also stimulated and supported by the nurse/occupational therapist present with the group.

There is a hypothesis that stimuli that are gathered around a positive theme exert a greater impact than the stimuli that are not, and there have been indications that light, having conversations, being with others, and having something to drink could in themselves exert effects on the psychological and behavioral problems and the sleep-wake disturbances. Therefore, in the present study, the afore-stated effects were controlled by allowing a neutral availability of these effects in the control condition. The control condition entailed visits to the nursing home's standard Grand Café room. The environment was referred to as the 'Grand Café' because the room looked similar to a normal café, where the residents were offered drinks (non-alcoholic) and were allowed to sit together around a table rather than alone. The room contained common items of old-fashioned furniture and attributes (e.g., lamps and a clock) as well as the Suntech Trippel Lamp (identical to the lamp placed in the Beach Room). It was decided to include the Suntech Trippel Lamp in both the conditions because, as reported by previous studies, the light from this lamp is itself expected to exert a positive impact on psychological and behavioral disturbances [16-18]. If the conversations did not evolve naturally among the residents in the Grand Café, a nurse/occupational therapist maintained the continuity of the conversation, which could be regarding any topic.

2.4 Procedure

The present study was conducted in the Dutch nursing home Vreugdehof in Amsterdam. Two nursing-home physicians attached to the two psychogeriatric wards participating in the study screened all the residents for eligibility. The residents were eligible if they: (1) had received a diagnosis of dementia, (2) had no comorbid psychiatric disorder, (3) were physically able to visit the Beach Room or the Grand Café environment, and (4) had not visited the Beach Room prior to the study. The legal guardians of each eligible resident were asked for their informed consent. All the residents for whom informed consent was obtained were assigned randomly to the Beach Room condition or the Grand Café condition. Randomization was conducted by the researcher (EvE) by writing the names of the eligible residents on a paper, folding the papers and putting them in a vase, and drawing papers from the vase one by one. First, the names of the residents selected for the experimental condition were drawn, followed by the names of those for the control condition. Randomization was conducted once per ward and per round. The residents assigned to one of the two conditions participated in the present study three times a week for 30 min for a period of 12 weeks. This intensity and duration were selected because previous studies had demonstrated that the effects of MSS could be expected after six weeks of using this intensity [19]. Additionally, this intensity would provide an insight into the follow-up effects at twelve weeks. The participating residents always visited the Beach Room or the Grand Café at the same time of the day and with a permanent group of three to five people from their own ward that was accompanied by a nurse or an occupational therapist. This cycle of 12 weeks was repeated three times within a period of one year. There were two participating groups in each cycle and for each condition. In this way, a total of six groups were included in the experimental condition and six groups were included in the control condition, which corresponded to 20 residents per condition. The residents were always asked if they wished to visit the Beach Room or the Grand café. At certain times, they would not wish to go or did not feel well enough for the visit, in which case, they were not forced to go. In both conditions, there was one person who did not wish to go at all. In each cycle, there were three measurement time-points for the assessments of depression, agitation, and apathy:

Pre-test: just prior to the beginning of the intervention;

Post-test: six weeks after the commencement of the intervention;

Follow-up: 12 weeks after the commencement of the intervention.

In addition, measurements of residents' sleep-wake cycles were noted, and the observations of their behavior and mood were recorded for five weekdays during the first, sixth, and twelfth weeks. A repeated measures design with pre-test, post-test, and follow-up measures was used, to enable an insight into the interim results.

2.5 Measurements

2.5.1 Socio-Demographic Characteristics and Preferences

The following characteristics of the participating residents were assessed using a questionnaire that was completed by the contact nurses at the time of inclusion in the study: age, sex, marital status (married, widow/widower, divorced, unmarried, and other), having children (yes/no), and duration of institutionalization (<3 months, 3 months–1 year, 1–3 years, and >3 years). In addition,

preferences for beaches (yes/no) and Grand Cafés (yes/no) were assessed via the legal guardians of the residents after the allocation of the residents to one of the two conditions. Most of the residents with dementia present in the Dutch psychogeriatric nursing home wards suffer from moderate dementia (Global Deterioration Scale: stage 5) or moderately severe dementia (Global Deterioration Scale: stage 6) ([20]. If the residents were in the severe dementia phase (Global Deterioration Scale: stage 7) and were unable to move out of bed anymore, they were considered ineligible for participation in the present study. Since the differences among the Global Deterioration Scale stages of the residents were assumed to be minimal (stage 5 moderate dementia or stage 6 moderately severe dementia) in both the experimental conditions, this was not investigated any further. Additionally, the type of dementia is mostly unknown and could, therefore, not be used in the analyses.

2.5.2 Primary Outcome Measures

The primary outcome measures were:

- Depression, measured using the MDS-Depression Rating Scale (DRS), with scores ranging from 0 to 14. A score of ≥3 indicated that a person was at an increased risk of being depressed [21]. The internal consistency of the DRS has been established at 0.71 (Cronbach's α), while the sensitivity of this scale against a formal diagnosis of depression was 91%. The scale was developed specifically for the assessment of depression in the frail nursing home population on the basis of Certified Nursing Assistants observations [21]. Cornell Scale for Depression in Dementia (Dutch version) was also employed. A score of ≥8 in this scale indicated minor depression, while a score of ≥12 indicated moderate-to-severe depression [22]. The Cornell scale has a high inter-rater reliability (weighted Kappa = 0.67) and internal consistency (Cronbach's α = 0.84) and was developed specifically for the assessment of depression in the people with dementia [22].
- Agitation, assessed using the Cohen-Mansfield Agitation Inventory, with scores ranging from 29 to 203. A score of ≥44 indicated agitation (CMAI) [23, 24]. The reliability of the inventory was investigated through test-retest, Cronbach's alpha, and split-half methods, which were determined to be 0.99, 0.92, and 0.82, respectively. The validity of the questionnaire was investigated through convergent validity, inter-rater agreement across items, and exploratory factor analysis. The results from the factor analysis of the CMAI using varimax rotation method yielded 4 factors labeled as Aggressive Behaviors, Non-Aggressive Behaviors, Verbal Aggression, and Hiding Behaviors, which explained 73% of the total variance. Convergent validity was confirmed by computing a correlation coefficient between the subscales together and with the total scale, which was significant between 0.43 and 0.90 ($p < 0.01$) [25].
- Apathy, measured using the Apathy Evaluation Scale, with scores ranging from 10 to 40. A score of ≥30 indicated apathy (AES) [26]. The internal consistency was determined to be excellent. In regard to congruent validity, the AES-10 and NPIa exhibited a moderate positive correlation, and when compared to a depression measure (CSDD), little or no positive correlation was observed, demonstrating satisfactory discriminant validity [27].

All four scales were previously validated in nursing-home residents with dementia. The scales were completed by the contact nurses of the residents.

2.5.3 Secondary Outcome Measures

The secondary outcome measures were as follows:

- Sleep-wake cycles, assessed using Actiwatch activity monitor (CamNtech Ltd., Cambridge, UK). Actiwatch uses an accelerometer to monitor the occurrence and the degree of movement-induced accelerations. It is worn around the wrist. It provides a feasible, non-invasive technique for studying sleep-wake cycles in institutionalized people with dementia, and is sensitive to treatment effects [16, 28]. Actiwatches were worn for five days a week, 24 h each day, during the three measurement periods. The watches were held around the wrist by a bracelet that could be removed by cutting it through. When the participants did not wish to wear the Actiwatch any longer, the watch was removed. The Actiwatch data was then used to obtain information regarding the four aspects of sleep-wake cycle: (1) total mean activity across the days; (2) sleep efficiency on a scale (the time a person spends asleep in proportion to the total time spent in bed), ranging from 0% to 100%; (3) average sleep time across the days; and (4) sleep per night expressed as mean percentage per day.
- Behavior of the residents, measured using the observation scale INTERACT. This observation scale has been designed specifically to measure the effects of multi-sensory stimulation on: speech (5 items; score 0–25); contact (4 items; score 0–20); reaction (4 items; score 0–20); stimulation (1 item; score 0–5); activities (4 items; score 0–20); and mood (4 items; score 0–20) [29]. A study conducted on the effects of Snoezelen integration in 24-h dementia care by Van Weert et al. [30] demonstrated inter-rater reliability of 0.83 (range: 0.68–0.99) for INTERACT.
- Mood of the residents, assessed using the INTERACT mood subscale and the observation scale FACE. The instrument FACE has been previously proved to be reliable in a severely demented and institutionalized population [31]. FACE comprises three face diagrams with different mouth shapes. Mood is rated as ☺ if smile predominates in the resident, 😐 if the expression remains neutral mostly, and ☹ if frown is predominant. Scores in FACE range from 1 (happy) to 3 (sad). The Intra-class Correlation Coefficient (ICC) for the average FACE measures during the morning care was determined to be 0.88 (CI: 95%; range: 0.53–0.99) on the basis of observations of eight research assistants. Both INTERACT and FACE scales were completed by trained research assistants, who were blind to the research questions, prior to, during, and directly after the interventions. 'Mood' was added as a secondary outcome, so that an insight into the direct effects of the intervention on the residents' mood could also be obtained. This was in addition to the further generic measures of depression that were answered by certified nursing assistants on the basis of their impression of the presence of depressive symptoms during the previous week.

2.6 Statistical Analysis

The present study followed the principles of intention-to-treat analyses: all the data associated with all residents participating in the present study were analyzed on the basis of the group they were initially (and randomly) assigned to, irrespective of whether they dropped out in-between or completely adhered to the treatment. Multi-level repeated measures analyses were conducted to analyze the data of the CMAI, MDS-Depression Rating Scale, Cornell, FACE, INTERACT and AES, as

well as to analyze the correlation with sleep-wake cycles [32, 33]. The analyses were performed using the MLwiN software [34]. Daniel et al. [35] concluded in their study that multi-level analysis is the best type of analysis in the cases with small sample sizes. Analysis of the Actigraph data was performed using the Actiwatch software (Cambridge Neurotechnology, Cambridge, England) and multi-level repeated measures analysis for continuous measurements over time with auto-correlated errors (see [36]). In the multi-level analysis, three different levels were distinguished: (1) measurement, (2) resident, and (3) ward. The multi-level model takes proper account of all the available data yielding outcome measures – the paired samples of the residents who underwent two or three among all the tests (pre-test, post-test, and follow-up), as well as the unpaired pre-measurement data of the residents for whom only pre-test data were available. The correlated paired measurements were controlled for by modeling the covariance between the measurements at residents' level [32, 33]. Sex, marital status, having children, and preference for beaches and/or Grand Cafés were used as covariates in the model. Data of the residents with complete covariate data (n = 35) were analyzed using the intention-to-treat principle – all the participants were analyzed according to their group assignment. In case of all the pre-test, post-test, and follow-up outcome measures, the adjusted estimated means and standard errors were calculated for both Beach Room and Grand Café conditions. The adjusted estimated means were the average scores corrected for the scores in the baseline measurement and the other covariates. In order to compare the differences in trends from pre-test to follow-up (linear or quadratic) between the experimental group and the control group, chi-squared statistics (df = 1) were calculated. If chi-squared ≥ 3.84 ($p \leq 0.05$), the trends were considered differing significantly. Both linear and quadratic differences were calculated as it was possible that the effects of Beach Room and Grand Café conditions were larger at post-test (6 weeks) than at the follow-up (12 weeks). Owing to missing Actigraph data for 20 residents in the post-test dataset for sleep-wake cycles, it was possible to analyze the change in the sleep-wake data only between pre-test (baseline) and follow-up (12 weeks). Data were missing because Actiwatches were not available during the post-test measurement period of these residents, while this was not the case for pre-test and post-test periods. The comparability between the experimental group and the control group was evaluated using independent t-tests and Chi-squared tests ($p \geq 0.05$) (STATA version 11) on the following background characteristics: age, sex, having children, and duration of stay.

2.7 Ethical Statement

The present study was approved by the Medical Ethics Committee of the VU University Medical Center (Protocol number 12/432). Informed consent was obtained from the legal guardians of the residents of the two participating wards. Only the members of the research team (the authors) had access to the study data.

3. Results

3.1 Study Population

A total of 60 residents were staying in the two wards of the nursing home at the time of the inclusion of residents in the present study. Among these 60 residents, five were excluded from participation because of comorbid psychiatric illness or because they were not sufficiently mobile.

Informed consent to participate in the present study was obtained from the legal guardians of all the remaining 55 residents. Among these 55 residents, only 49 eventually participated in the study because each condition offered room for a maximum of only three to five residents (depending on the types of wheelchairs used by the residents). Certified nursing assistants formed combinations of the residents who got along well together and for whom there was enough room.

Figure 1 illustrates the participant flow. In the end, 35 among the 49 residents included in the study completed the follow-up: 18 residents in the Beach Room group and 17 residents in the Grand Café group.

Table 1 presents the background characteristics of the participating residents at the pre-test. The results of the independent t-tests and Chi-squared tests (STATA version 11) revealed that there were no significant differences ($p \geq 0.05$) between the characteristics of the two groups in terms of age (mean: 86.9 years), sex (75% were female), having children (79% had children), and duration of stay (49% ranged between three months and one year).

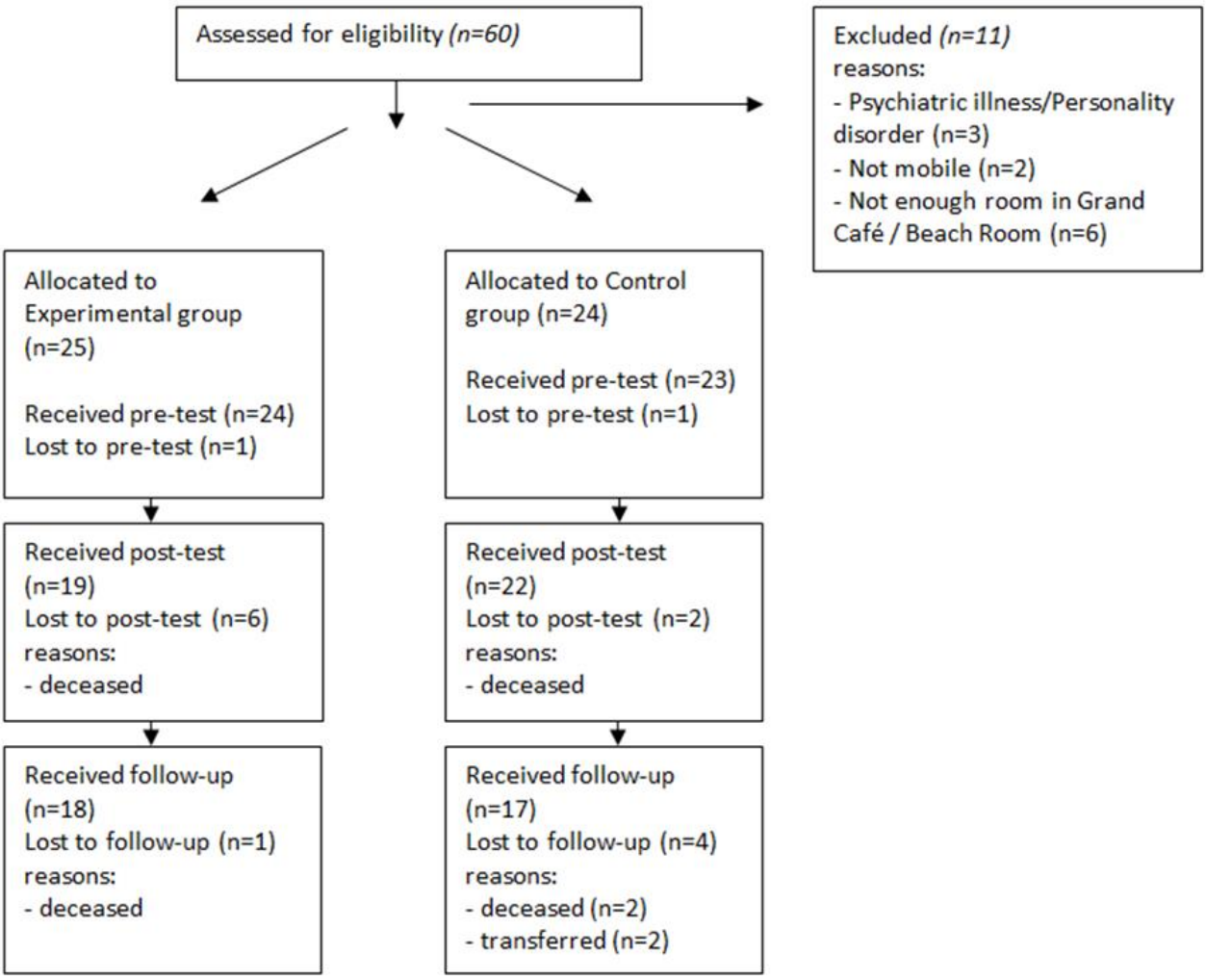

Figure 1 Participant flow.

Table 1 Background characteristics of the participants (n=47).

	Beach Room (n=24)	**Grand Café (n=23)**
Age, years (mean ± SD)	87.6 (±6.9)	86.3 (±5.9)
Sex female, n (%)	17 (71%)	18 (78%)
Marital status		
Married, n (%)	5 (21%)	2 (9%)
Widow/widower, n (%)	14 (58%)	15 (65%)
Divorced, n (%)	3 (13%)	1 (4%)
Never married, n (%)	1 (4%)	4 (17%)
Other, n (%)	1 (4%)	1 (4%)
Children		
Yes, n(%)	20 (83%)	17 (74%)
Duration of institutionalization		
<3 months, n (%)	0 (0%)	1 (4%)
3 months – 1 year, n (%)	10 (42%)	13 (57%)
1 – 3 years, n (%)	9 (38%)	4 (17%)
> 3 years, n (%)	5 (21%)	5 (22%)

No significant differences between the Beach Room and Grand Café conditions ($p \geq .05$).

3.2 Depression, Apathy, and Agitation

According to the MDS/RAI-DRS or the Cornell, no improvements in depression were observed among the residents that visited the Beach Room. The residents who were assigned to the Grand Café condition exhibited a significant reduction in depression, as measured with the MDS/RAI-DRS, from baseline to follow-up, while no differences from the baseline to follow-up were observed with the Cornell. The difference in trends from baseline to follow-up between the Grand Café group and the Beach Room group, as measured with the MDS/RAI-DRS, was also significant (Table 2).

In regard to apathy, a significant improvement was observed from baseline to follow-up in the residents who visited the Grand Café, while no improvement was observed in the residents who visited the Beach Room. However, no significant differences in trends from baseline to follow-up were observed between the Beach Room and the Grand Café conditions. Furthermore, the results presented in Table 2 indicated that there were no significant changes in agitation, neither between the conditions nor between the residents belonging to the two groups.

3.3 Sleep-Wake Cycles

The outcomes of the Actiwatch data analysis revealed no significant changes between the baseline and the follow-up in the Beach Room condition. In the Grand Café condition, a significant improvement was observed in sleep efficiency as well as in the percentage sleep per night from baseline to follow-up. These trends were also significant when compared to the trends observed for the Beach Room condition. No changes were observed in the activity levels and the mean sleep time per night in either of the conditions (Table 3).

Table 2 Differences in psychological and behavioral problems between the Beach Room and Grand Café conditions.

Outcome measures	**Pre-test Adjusted Estimated Means (SD)**		**Post-test Adjusted Estimated Means (SD)**		**Follow-up Adjusted Estimated Means (SD)**		**Differences in trends**	**Differences in trends**
	Beach	**Café**	**Beach**	**Café**	**Beach**	**Café**	**χ2 – linear**	**χ2 -quadratic**
Depression								
- MDS/RAI-DRS (0-14)	1.73 (0.68)	**2.16 (0.67)**	2.10 (0.92)	**1.66 (0.90)**	1.79 (0.63)	**1.13 (0.62)***	**4.14****	0.11
- Cornell (0-38)	6.68 (0.63)	6.78 (0.63)	7.00 (1.22)	8.64 (1.23)	6.98 (0.48)	7.15 (0.49)	0.02	1.12
Agitation								
- CMAI (29-203)	41.41 (4.24)	41.49 (4.04)	38.34 (4.03)	37.28 (3.83)	41.74 (4.58)	36.63 (4.55)	3.19	2.48
Apathy								
- AES (10-40)	30.61 (3.21)	**27.84 (3.14)**	32.16 (3.26)	**32.35 (3.11)**	32.19 (3.13)	**31.65 (3.06)***	0.91	1.10

*significant trend from pre-test to follow-up within the tested group

** significantly different trends in the Beach and Café groups from pre-test to follow-up in favor of the Grand Café group (chi-square, 1 degree of freedom)

-The underlined scores in brackets after the measures indicate the most favorable score for the scale. Mean = estimated mean score (multilevel analysis); se = standard error; χ^2 = chi-square (1 degree of freedom); MDS/RAI-DRS = Minimum Data Set/Resident Assessment Instrument-Depression Rating Scale-Dutch version; Cornell = Cornell scale for depression in dementia-Dutch version; CMAI = Cohen Mansfield Agitation Inventory-Dutch version; AES = Apathy Evaluation Scale-Dutch Version.

Table 3 Differences in the activity and sleep based on Actiwatch registrations between the Beach Room and Grand Café conditions.

Outcome measures	**Pre-test Adjusted Estimated Means (SD)**		**Follow-up Adjusted Estimated Means (SD)**		**Differences in trends**
	Beach	**Café**	**Beach**	**Café**	**χ^2 – linear**
Activity					
Average total activity across the days.	1.746 (8.203)	1.986 (8.135)	1.851 (7.476)	1.924 (7.596)	0.57
Sleep					
Sleep efficiency% (0-100) The total time that a person sleeps as a percentage of the total time spent in bed.	77.51 (6.68)	**74.62 (6.68)**	74.84 (7.06)	**84.46 (7.26)***	**4.62****
Sleep time (minutes) Average sleep time per day.	353.9 (87.23)	358.6 (85.55)	348.6 (70.61)	426.2 (74.96)	1.82
Sleep% (0-100) Mean percentage sleep per night across the days.	82.24 (5.48)	**78.49 (5.55)**	79.11 (5.55)	**88.37 (5.83)***	**7.20****

*significant trend from pre-test to follow-up within the tested group

** significantly different trends in the Beach and Café groups from pre-test to follow-up in the favor of the Grand Café group (chi-square, 1 degree of freedom)

3.4 Observed Behavior and Mood

According to the observations based on FACE, there was a significant improvement in mood in the Beach Room condition, while no such difference was observed in the trend in the Grand Café condition. In the case of mood measurements based on INTERACT, a significant improvement was observed from baseline to follow-up in the residents who visited the Grand Café. However, this effect was not significant when compared to the trend in the Beach Room condition. According to the observations based on INTERACT, there were significant improvements between baseline and follow-up in terms of speech, contact, response, and stimulation, in the Grand Café condition. This effect was also not significant when compared to the trend in the Beach Room condition (Table 4).

Table 4 Differences in observations of behavior and mood between the Beach Room and Grand Café conditions.

Outcome measures	**Pre-test Adjusted Estimated Means (SD)**		**Post-test Adjusted Estimated Means (SD)**		**Follow-up Adjusted Estimated Means (SD)**		**Differences in trends**	**Differences in trends**
	Beach	**Café**	**Beach**	**Café**	**Beach**	**Café**	**χ2 – linear**	**χ2 -quadratic**
Behavior								
INTERACT								
- Speech (0-25)	6.65 (2.53)	**8.93 (2.43)**	7.55 (2.51)	**4.42 (2.52)**	7.8 (2.50)	**9.70 (2.50)***	0.03	3.65
- Contact (0-20)	7.27 (2.04)	**7.35 (1.97)**	7.12 (2.16)	**6.43 (2.08)**	7.69 (2.00)	**8.93 (1.95)***	1.14	0.96
- Reaction (0-20)	7.81 (1.46)	**6.91 (1.41)**	6.10 (1.58)	**5.95 (1.55)**	7.62 (1.41)	**8.61 (1.40)***	2.88	0.02
- Stimulation (0-5)	2.05 (0.32)	**2.09 (0.30)**	1.95 (0.34)	**1.59 (0.33)**	2.36 (0.38)	**2.34 (0.37)***	0.05	1.06
- Activities (0-20)	12.46 (1.05)	13.59 (1.05)	13.77 (1.53)	13.57 (1.53)	13.15 (0.93)	14.26 (0.97)	0.00	0.47
Mood								
INTERACT								
- Mood (0-20)	17.87 (0.66)	**17.1 (0.65)**	18.15 (0.59)	**17.65 (0.61)**	18.73 (0.50)	**18.29 (0.51)***	0.17	0.03
FACE (1-3)	**1.61 (0.16)**	**1.61 (0.15)**	**1.48 (0.16)**	**1.81 (0.16)**	**1.32 (0.14)***	**1.40 (0.13)***	0.19	2.97

*significant trend from pre-test to follow-up within the tested group

4. Discussion

In contrast to what was expected, no improvements in depression, apathy, agitation, sleep-wake cycles, and observed behavior were achieved with the use of enriched thematic multi-sensory stimulation conditions (the Beach Room). These conditions did lead to a small improvement in mood, although even this improvement was not significantly different from the trend observed in the control condition (the Grand Café condition). The control condition was observed to lead to improvements in depression, apathy, and sleep. At follow-up, the residents who had visited the Grand Café exhibited significantly fewer signs of depression (MDS/RAI-DRS) and apathy and better sleep efficiency. The improvements in depression and sleep efficiency observed in the control Grand Café condition were also significant when compared to the experimental Beach Room condition.

One possible explanation for such findings, i.e., no psychological and behavioral changes in the Beach Room condition, could be that the theme of the beach and the related stimuli (e.g., the sounds of the sea, the feel of the sand, etc.) are associated with inactivity in Dutch culture. It is possible that for this population of nursing-home residents, who remain inactive most of the time, a more active environment such as that of a Grand Café is necessary to exert positive effects in regard to psychological, behavioral, and sleep problems. Observations based on INTERACT confirmed that the residents in the Grand Café condition exhibited higher activity compared to the residents in the Beach Room. Research indicates that being active may enhance sleep-wake cycles, which could, in turn, lead to improvements in regard to feelings of depression and apathy [37].

Another potential explanation is that the residents in the Grand Café condition were more exposed to daylight in comparison to the residents in the Beach Room condition. Higher exposure to daylight was because: 1) the Grand Café environment had windows; 2) residents in the Beach Room wore sunglasses as opposed to the residents in the Grand Café environment that didn't, which could have prevented optimal absorption of light from the lamp. Research has demonstrated that exposure to daylight is able to positively affect the behavioral and psychological disturbances as well as the sleep-wake cycles in people with dementia [16-18].

Therefore, considering these two possible explanations, physical activity and exposure to daylight might be having a greater role in providing effectiveness in reducing behavioral and psychological disturbances in the nursing-home residents with dementia, in comparison to enriched thematic multi-sensory stimulation. Therefore, further research that includes controls for exposure to daylight and physical activity in the study design is required.

Another finding that warrants reflection is the fact that effects on depression were observed when measurements were performed using the MDS/DRS-RAI and not when using the Cornell scale for depression in dementia. An explanation for this might be provided by the study conducted by Kurlowicz et al. [38], who reported in regard to their evaluation of the Cornell scale, the following conclusion: "...in frail, institutionalized older adults exhibiting high rates of dementia, medical illness, and functional disability, the measurements of depression that are less dependent on the items highly sensitive to comorbid conditions and not necessarily associated with depression may be more appropriate". Examples of the items in the Cornell that are sensitive to comorbid conditions include 'multiple physical complaints' (item 7) and 'weight loss' (item 10). The DRS, which was developed specifically for the assessment of depression in frail nursing-home

population, is less dependent on physical conditions, and could, therefore, serve as a suitable example of a 'more appropriate' instrument.

Comparable studies that examine the effects of thematic multi-sensory stimulation in people with dementia are scarce, causing difficulty in determining the effectiveness of (enriched) thematic multi-sensory stimulation and identifying the key elements resulting in this effectiveness. Goto and colleagues reported obtaining a positive effect of thematic multi-sensory stimulation, in the form of a Japanese garden, on the stress levels and the behavior of the nursing-home residents with dementia [14, 15]. The effects observed in their study could be attributed to the residents being active and exposed to daylight, as opposed to the arousal of positive memories or the reinforcement of stimuli through thematic stimulation.

Studies examining the effects of psychosocial interventions on disturbances in the sleep-wake cycles in people with dementia are also scarce [39]. The present study indicated that achieving positive outcomes in this regard did not require the application of enriched thematic multi-sensory stimulation, and it could rather be achieved by employing less complex interventions such as non-thematic interactions in a standard Grand Café setting. However, not all the measured indicators of sleep–wake cycles in the residents who visited the Grand Café setting exhibited improvement. Therefore, further research is required for identifying the elements of psychosocial interventions that could be playing a role in enhancing the aspects of sleep-wake cycles.

5. Limitations

While the present pilot study is among the first to explore the effects of thematic multi-sensory stimulation on psychological and behavioral disturbances in dementia and on sleep-wake cycles, it nonetheless has certain limitations.

Firstly, the study explored the effects of only one type of enriched thematic multi-sensory stimulation. It is possible that other types of enriched thematic multi-sensory stimulations, such as the Japanese Garden or a flower garden, exhibit higher effectiveness in improving psychological and behavioral disturbances, in line with the results reported previously by Goto and colleagues [14, 15], for example.

The second limitation was that the present study did not employ control for the influence of daylight sufficiently. Although the same lamp was used in both the conditions, there was the presence of natural light in the control setting and sunglasses in the experimental one, which might have interfered with the results associated with the effects on mood and sleep. However, the manner in which this might have affected the outcomes is unknown.

The third limitation was that it was a pilot study based on small sample size. Although the study had sufficient power to establish certain effects in the Grand Café condition, future research involving larger samples are required to formulate definitive conclusions.

The fourth limitation was that the present study did not systematically assemble information from the participants themselves regarding how the environments made them feel, which could have provided greater insight into the (non) effective elements and the possible working mechanisms. Future research should, therefore, use a mixed-method design, in which qualitative information from the residents themselves is also obtained and utilized.

6. Conclusions

The results of the present study indicated that enriched thematic multi-sensory stimulation does not necessarily exhibit higher effectiveness in reducing psychological and behavioral problems among nursing-home residents with dementia compared to stimulation that is not enriched. The control condition comprising a Grand Café environment, which included extra daylight, exhibited higher effectiveness. Further investigation to unravel the effective elements and the possible working mechanisms is recommended for future research in this area.

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Author Contributions

Renate Verkaik designed the experiments, analyzed data, drafted and revised the manuscript. Erik Scherder and Anneke Francke designed the experiments and drafted the manuscript. Eugenie van Eerden acquired data. Peter Spreeuwenberg analyzed data. Iris van der Heide drafted the manuscript.

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Competing Interests

The authors have declared that no competing interests exist.

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