



# Using an Accessible Room Multisensory Stimulation Environment to Reduce Dementia Associated Behaviors

## RESEARCH

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## ABSTRACT

**Objectives:** To reveal whether an accessible open floorplan Multisensory Stimulation Environment (MSSE) room design has a positive impact as a nonpharmacologic intervention for episodes of Behavioral and Psychological Symptoms of Dementia (BPSD) in older adults living in a Memory Care Assisted Living (MCAL) facility as well as reducing the need for direct care supervision.

**Methods:** Retrospective pre/post cohort design of 24 residents living in a Midwest MCAL facility in the United States with a diagnosis of dementia and over 65 years of age, analyzed by secondary medical chart review for 12 months to assess impact of an accessible open floorplan MSSE room design. The pre/post design analyzed secondary data over two periods of time; 6 months prior to the MSSE installation and 6 months following the MSSE installation.

**Results:** Following the installation of an open floorplan MSSE, the number of observed BPSD episodes changed from 367 (17%) pre-test to 298 (10%) post-test over a 12-month time period. The Comparison of Proportions test determined that the difference in the proportion of BPSD episodes documented was statistically significant with clinical implications.

**Conclusions:** The accessible open floorplan MSSE room design, located within a single-site MCAL facility, utilized as a nonpharmacological intervention for BPSD, was found in this explorative study to be effective and potentially clinically meaningful in improving behavioral episodes for older adults diagnosed with dementia in MCAL settings.

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## INTRODUCTION

The population of older adults is rapidly growing, with persons 65 and older in the United States (US) increasing from 48 million in 2015 to a projected 88 million by 2050 (NIA, 2016). Additionally, an estimated 55 million people worldwide were living with dementia in 2020, with this population estimated to climb to 78 million by 2030 (Gauthier et al., 2021). The extent and projected growth of this population, with more than 10 million new cases every year, has led to the identification of the clinical spectrum of dementia as a significant global health and public health concern (Gauthier et al., 2021; WHO, 2021). At the same time, the issue is complicated in the US by an expected shortage of nurses, which will only intensify as the aging population—including cases of dementia diagnoses—grows, along with a higher demand for a specialized health care work force (Chenoweth et al., 2010; AACN, 2020). Moreover, this medical staffing shortage has been greatly exacerbated by the COVID-19 pandemic (Cahan et al., 2020).

Caring for older adults with varying forms of dementia requires direct supervision by care providers. These providers may include relatives, hired private-duty caregivers, and personnel who work in long-term care facilities, such as Assisted Living Facilities (ALF) and Skilled Nursing Facilities (SNF). Caregivers working in an ALF may be unlicensed personnel with specific training provided by the facility, a Certified Nursing Assistant (CNA), or a licensed nurse. Additionally, persons diagnosed with dementia often display behavioral symptoms such as aggressiveness, wandering, depression, agitation, anxiety, repetitive activity, and nighttime disturbances. These are collectively referred to as Behavioral and Psychological Symptoms of Dementia (BPSD) (Alzheimer's Association, 2017). Observation studies reveal that persons diagnosed with dementia often experience BPSD due to sensory deprivation or even over-stimulation and consequently often experience intra-psycho discomfort due to these imbalances (Sánchez et al., 2013). In light of this, both pharmacological and nonpharmacological treatment strategies have been proposed. Given the lack of an effective pharmacological cure or control for symptoms of BPSD, nonpharmacological interventions or therapies are increasingly important, including the ability to provide stress-reducing as well as entertaining environments for this clinical population (Sánchez et al., 2013; Pinto et al., 2020; Ferrero-Arias et al., 2011).

A multisensory stimulation environment (MSSE) treatment room is one example of a nonpharmacological intervention (Sánchez et al., 2013; Pinto et al., 2020; Ferrero-Arias et al., 2011; Lorusso and Bosch, 2018; Chung and Lai, 2002). The development in support of MSSEs goes back to the 1970–80s, as part of a broader effort to both better understand the relationship of the built environment and the people interacting with it and

the potential of utilizing the physical environment as a therapeutic tool (Calkins, 1988). MSSEs are traditionally used as an alternative, nonpharmacologic, therapeutic intervention for BPSD by reducing maladaptive behaviors, promoting positive behaviors, increasing positive mood, promoting a caregiving relationship, and reducing caregiver stress (Calkins, 1988; Milev et al., 2008). MSSE rooms commonly include low lighting and objects catering to the human senses with aroma, sound, water columns, fiber-optic lighting, textured materials, and screen projection (Milev et al., 2008). The nature of the intervention may vary considerably and may or may not include the provision of trademark-regulated Snoezelen environments. There is a growing body of literature showing that MSSE rooms have an ability to improve BPSD symptoms, including systematic reviews and a Cochrane review of the efficacy of Snoezelen multisensory programs for dementia (Sánchez et al., 2013; Pinto et al., 2020; Ferrero-Arias et al., 2011; Lorusso and Bosch, 2018; Chung and Lai, 2002; Milev et al., 2008; Collier et al., 2010). For example, one study reported findings from a 24-week study of 29 subjects that persons with dementia receiving weekly MSSE treatments showed improved health and emotional outcomes, which were maintained following cessation of the program (Milev et al., 2008). However, the variations in the form and application of MSSE interventions in care for residents with dementia have resulted in a continued need for additional research on the efficacy of such applications across different populations and care environments (Chung and Lai, 2002). This includes opportunities to transform the enclosed-MSSE concept to incorporate design options that increase opportunities for residents to autonomously interact with others and the environment while also maintaining personal interests, as is recommended by gerontologists to enhance autonomy while preserving safety for a person-centered care approach in light of the COVID-19 pandemic (Saunders et al., 2021).

While these new formats and technologies are emerging, the vast majority of existing literature describes the use of an MSSE requiring a caregiver to individually escort the subject to the MSSE treatment room, with the caregiver then required to spend time with the subject until the duration of the treatment is met. Indeed, one-on-one care are hallmark of many MSSE interventions (Sánchez et al., 2013; Lorusso and Bosch, 2018; Chung and Lai, 2002). However, due to continued shortages of the nursing workforce in the US, it is neither feasible nor reliable to continue to provide an undetermined amount of a sole caregiver's time to residents experiencing BPSD as this process removes the staff member from the ability to provide care to other residents. Normally, MSSE designs are located in an isolated room with a door to prevent access from other residents of an ALF or SNF while the MSSE is in use. In this case study, the MSSE utilized some of the newer technology and design ideas;

locating the MSSE in an existing common area within a secure MCAL unit intended to be easily accessible by the residents of the unit. Important from the perspective of some of the newer designs, this location encouraged interaction among groups of residents in the unit. As it did not provide Snoezelen trade-marked environments, it is considered an MSSE-based therapy. Such advanced designs have been recently adapted by memory care communities as a response to the need for a person-centered care approach as well as responding to staffing challenges, while still striving to promote a multisensory environment that can be autonomously accessed by the residents of a memory care unit (Bonvissuto, 2022). This MSSE intervention is unique in that it provides both calming and stimulating sensory elements for older adults diagnosed with dementia without the need for constant one-on-one interaction with care staff; an important contribution given the intensifying workforce shortages being experienced nationwide. The model is like that being employed elsewhere in response to the staffing shortages being experienced. The key question, then, is regarding the efficacy of these efforts on episodes of BPSD. The purpose of this study was to examine the outcomes of an accessible room MSSE among residents of an MCAL center on episodes of BPSD.

## METHODS

This study was conducted by a secondary, aggregated, data analysis of the medical records from a single collection MCAL facility. The pre-intervention data were collected during the six months prior to the build and use of an open floorplan MSSE room design located in an MCAL facility between the months of September 2017 to February 2018. The post-intervention data consisted of the six-month period following the installation between the months of March 2018 to August 2018. The secondary data extracted from the medical records provided documentation of staff-reported episodes of BPSD on each shift, each day, for 12 months within an all-inclusive sample of 24 residents of an MCAL facility located in a metropolitan area of a Midwest state in the US. This research study received approval from the Western Michigan University Human Subjects Institutional Review Board. All statistical analyses were performed with the Statistical Package for the Social Sciences Version 25 (SPSS).

## PARTICIPANTS

The data for this exploratory study were obtained from secondary aggregated data retrieved from the medical records of an all-inclusive sample of older adults over the age of 65 years with a dementia diagnosis residing in a secured MCAL facility ( $n = 24$ ). The pre/post analysis took place over a 12-month period from September 2017 to August 2018, with installation of the MSSE taking place

in March 2018. The MCAL site used for this study has the capacity to accommodate a total of 20 residents on its enclosed unit. As participants moved out or passed away during the 12-month study, new residents moved into the vacant rooms.

## MEASUREMENT TOOLS

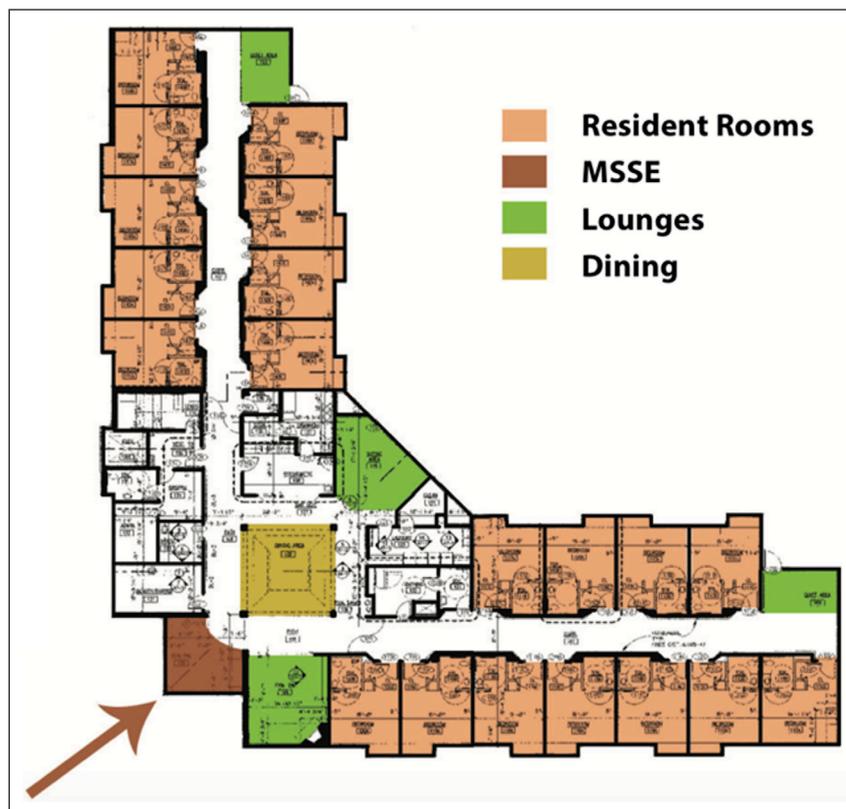
The study population resided in a 20-unit MCAL facility, having met the facility-determined criteria for admission. In order to meet criteria for admission to this MCAL, clinical staff at the MCAL facility conducted a Mini-Mental State Examination (MMSE) on each older adult prior to their admission. A score on the MMSE (Folstein et al., 1975) of 19 or less was required before approval for admission to the MCAL was granted by a physician. Next, the facility's Level of Care Assessment Tool (LOCAT; unpublished) was completed to determine level of care needs upon admission. The LOCAT was utilized to determine 14 different level of care needs based on a 0 to 130-point scale, and the older adult needed to have a rating between 29 to 65 points to be approved for residing in the MCAL. The psychometric quality of the tools used varied greatly as the MMSE is well established in the literature, unlike the LOCAT which is an in-house screening tool designed to assist the MCAL facility to determine the level of care and assistance needed at the point of admission.

## PROCEDURE

The study subjects were observed by the care providers of the MCAL on each shift as the residents voluntarily interacted in their living environment. The MCAL open floorplan designed setting was a secured unit including 20 apartments designated only for residents diagnosed with dementia. Due to the accessibility of the open floorplan design of the MSSE, the subjects could interact with the space independently and/or prompted by care staff when deemed appropriate (see Figure 1). As an open floorplan designed MSSE within the MCAL, residents were also permitted to voluntarily enter or exit the MSSE at any time. Residents were observed by care providers of the MCAL on each shift, with BPSD episodes documented in the residents' medical record.

## Environment design

The MSSE was created as an open floorplan accessible room design located in a common area of the MCAL secured unit which housed twenty apartments for older adults diagnosed with dementia and meeting criteria identified by the MCAL care providers. This MSSE was designed to permit residents of the MCAL to voluntarily enter and exit the MSSE at any time without the closure of the treatment space. This open floorplan design was created with the goal to reduce the need for care providers to escort a resident to utilize the space, with the additional benefit of the location of the MSSE across from the dining room allowing care providers to have the



**Figure 1** Floorplan of the Memory Care Assisted Living facility.

ability to directly view the resident’s use of the space from a distance to monitor for safety. Staff of the unit are commonly dispersed about the unit providing care, holding activities and events, and serving meals in the dining room throughout the day. However, a nurse’s station was located adjacent to the MSSE space, which allowed staff to be in proximity without personally escorting residents to utilize the intervention.

**Integrated Five Sensory Categories**

The MSSE open floorplan room design integrated five sensory categories, which included aroma therapy, visual stimulation, tactile, and vestibular elements. The aroma therapy consisted of a lavender scent diffuser; no other scents were used during the course of this study in order to standardize and maintain control of the aroma stimulant for the MSSE. The MSSE was designed to be fully automated by utilizing aroma therapy equipment that activated automatically.

The visual stimulation element consisted of LED up-lighting that projected up the walls of the space as well as low-lighting installed in the ceiling of the MSSE. This lighting was programmed to change at certain times of day, reducing the need for care providers to interact with the equipment. Settings for the lighting were pre-set to Relax-mode, Uplift, Evening, and Daytime, which corresponded to color related to the intended mood.

The audible elements were provided by an internal sound system, which could play soothing and stimulating sound sequences at the discretion of the care provider

activating the sound system. The sound system for this room was recessed into the ceiling of the room.

The tactile elements of the MSSE included varying textures of furniture and fabric carefully selected for the room. These tactile pieces included wooden furniture, tiled surfaces on coffee and side tables, wicker chairs, canvas and polyester textured pillows, as well as a brick wall, PVC railing which mimicked a picket fence, and glass windows.

Finally, the vestibular element was achieved with the placement of rocking chairs and glider chairs in the room. These chairs were accessible by the subjects without the need for assistance from a care provider to transfer to the seat for use.

**Documentation**

The care providers of the MCAL documented whether a resident exhibited signs of BPSD on the day and night shifts of each day. The documentation allowed for free text where the care provider could document whether a resident had a good day with no BPSD episodes or whether BPSD episodes did occur during the documented timeframes. The care provider completing the documentation did not account for whether the subject entered the MSSE on each shift as this was an open floorplan designed MSSE with an integrated experience within a secured MCAL unit.

**Variables**

The accessible open floorplan MSSE design located on the MCAL secured unit served as the independent variable for

this study. The documented BPSD episodes found in the subject’s medical record by the MCAL care providers was the dependent variable in this pretest-posttest analysis. The amount of time, or dosage, a subject spent utilizing the MSSE was not considered in this study as this was an open floorplan design in a secured MCAL setting.

## RESULTS

### RESIDENT DEMOGRAPHICS

Participants’ ages ranged from 77 to 97 years ( $M = 87.8$ ,  $SD = 4.9$ ) with 25% identified as men ( $n = 6$ ) and 75% identified as women ( $n = 18$ ). The subjects ranged from 0.10 to 6.10 years residing in the MCAL ( $M = 1.8$ ). The sample group consisted of 95.8% White, non-Hispanic ( $n = 23$ ) and 4.2% White, Hispanic ( $n = 1$ ) participants. The participant group consisted of 34.6% with an Alzheimer’s disease diagnosis ( $n = 9$ ), 34.6% with an unspecified dementia diagnosis ( $n = 9$ ), 15.4% with vascular dementia ( $n = 4$ ), 7.7% with Parkinson’s disease (PD) dementia ( $n = 2$ ), 3.8% with dementia with Lewy bodies (DLB) ( $n = 1$ ), and 3.8% with frontotemporal lobar degeneration (FTLD) ( $n = 1$ ). Only 29.2% of the population were able to ambulate on the unit without an assistive device ( $n = 7$ ), while 54.2% required a walker ( $n = 13$ ), 12.5% needed a wheelchair ( $n = 3$ ), and 4.2% utilized a wheelchair and a walker as needed ( $n = 1$ ) (see Table 1).

### BPSD EPISODES

The aggregated data retrieved from medical chart documentation listed observed BPSD episodes of each subject for each shift, equaling 5,159 total observations documented by MCAL staff during the analysis period between September 1, 2017, to August 31, 2018. The documented observations either noted that a BPSD episode was observed or ‘no behaviors observed’ as noted by the caregiver for each shift of work in the medical record. Following the MSSE installation in the MCAL center, the number of observed BPSD episodes decreased from 367 documented observations prior to the installation to 298 documented observed episodes after the installation (see Table 2). A total of 2,163 documented observations, either observing a BPSD episode or none observed, were documented prior to the installation of the MSSE, with 16.9% of total episodes documented as a BPSD episode. A total of 2,996 observations were documented after installation of the MSSE, with 9.9% of total episodes documented reported as a BPSD episode. The Comparison of Proportions analytical test was performed to determine the difference in the proportion of BPSD episodes documented pre- and post-intervention, which was reported to be both clinically and statistically significant,  $X^2(1) = 55.136$ ,  $p < 0.0001$ .

|  | <i>M</i> | <i>SD</i> | <i>MIN.</i> | <i>MAX.</i> |
|--|----------|-----------|-------------|-------------|
| Age in Years                             | 87.8     | 4.9       | 77          | 97          |
| Years residing at MCAL                   | 1.8      | 1.8       | 0.1         | 6.10        |
|  | <i>N</i> | <i>%</i>  |             |             |
| Sex                                      |          |           |             |             |
| Female                                   | 19       | 79        |             |             |
| Male                                     | 5        | 21        |             |             |
| Race, Ethnicity                          |          |           |             |             |
| White, non-Hispanic                      | 23       | 95.8      |             |             |
| White, Hispanic                          | 1        | 4.2       |             |             |
| Dementia Type                            |          |           |             |             |
| Alzheimer’s disease                      | 9        | 34.6      |             |             |
| Dementia with Lewy bodies (DLB)          | 1        | 3.8       |             |             |
| Frontotemporal lobar degeneration (FTLD) | 1        | 3.8       |             |             |
| Parkinson’s disease (PD) dementia        | 2        | 7.7       |             |             |
| Unspecified                              | 9        | 34.6      |             |             |
| Vascular dementia                        | 4        | 15.4      |             |             |
| Assistive Mobility Device Use            |          |           |             |             |
| None required                            | 7        | 29.2      |             |             |
| Walker                                   | 13       | 54.2      |             |             |
| Wheelchair                               | 3        | 12.5      |             |             |
| Walker and Wheelchair                    | 1        | 4.2       |             |             |

**Table 1** Descriptive Statistics of the Participants.

Note: *M* = Mean, *SD* = Standard deviation, *Min.* = Minimum value, *Max.* = Maximum value.

| BPSD EPISODE       | MSSE, PRE-TEST | MSSE, POST-TEST |
|--------------------|----------------|-----------------|
| Yes                | 367            | 298*            |
| None Observed      | 1,796          | 2,698           |
| Total Observations | 2,163          | 2,996           |

**Table 2** Documented BPSD Observed Episodes Before and After MSSE Installation.

Note: BPSD = Behavioral and Psychological Symptoms of Dementia, MSSE = Multisensory Stimulation Environment.

\* Statistically significant  $p < 0.000$ .

## DISCUSSION

This study aimed to address the current gaps in literature of the utility of an open floorplan MSSE room design located on an MCAL unit intended for independent use by ambulatory older adults diagnosed with dementia. We postulated that the installation of an accessible room MSSE design could reduce the episodes of BPSD

in older adults diagnosed with dementia. The findings of this intervention are consistent with other research on the efficacy of MSSE in the care of this population. For example, a systematic literature review of 12 studies published between the years of 1990 and 2015 found that 12 of the studies reviewed reported positive results regarding the impact of the MSSE treatment on BPSD, particularly noting an overall decrease in the number of BPSD incidences associated with this nonpharmacological behavioral treatment (Lorusso and Bosch, 2018). More recent studies and reviews have also identified the MSSE as potentially effective at managing mood and behavioral disturbances in the short term, further highlighting the promise of nonpharmacological treatments for dementia (Lorusso and Bosch, 2018; Agusman, Hani and Indah Iswanti, 2020; Cheng et al., 2019; Maseda et al., 2018). While it is still difficult to make a definitive conclusion regarding the effectiveness of multisensory rooms compared to other treatment modalities for improving BPSD and other symptoms in individuals with dementia, there is a growing consensus that some important improvements can be achieved, particularly in the short-term, using such stimulation environments in MCAL settings (Banerjee and Ford, 2020).

Moreover, the results of this study suggest that an open floorplan MSSE can be designed in a location within an enclosed MCAL unit that can be entered and exited freely by older adults with dementia, without requiring a caregiver to escort residents to use the space with direct observations of reported reductions in BPSD. This later consideration is particularly important in the face of nursing shortages that have accelerated during the present pandemic (McLernon, 2020). These shortages have particularly impacted nursing homes and assisted living facilities (ACHA and NCAL). Institutional stress experienced during the response to the COVID pandemic, both in the US and globally, coupled with existing staff shortages, has forced many healthcare systems to consider the adoption of new technologies that not only improve patient care, but allow for care and services to shift virtually, thereby reducing workloads on already overburdened staff (Dykes, 2021). The global pandemic has also highlighted the urgent need for nurses to become involved in technology design and implementation; a consideration that extends to all systems, including nursing homes and MCAL facilities. Moreover, intentionally linking labor-saving designs such as the one described in Andrew Carle's work at The Virginian at Shenandoah in their sensory lounge fosters a new model of care (Bonvissuto, 2022).

The use of nonpharmacological intervention for older adults diagnosed with dementia and suffering from BPSD is significantly relevant in current clinical practices. The population of older adults is increasing dramatically along with the increase in diagnoses of dementia. Additionally, the clinical workforce is continuing to

decline, with patient-to-caregiver ratios shifting. The use of the MSSE is growing in popularity in nursing homes and has been shown to be a successful alternative to psychotropic medications to reduce BPSD. This study reveals that an open floorplan MSSE room design has the potential to have a positive impact in reducing the reported BPSD episodes in an accessible room setting without the need for a care provider to dedicate direct supervision to an ambulatory older adult diagnosed with dementia.

## LIMITATIONS

The limitations of the present study include the inability to generalize the accessible open floorplan room design in other MCAL settings as any alterations in floorplan, subject population, and caregiver population may alter results. The present study did not control for the time (dosage) subjects utilized the MSSE as an intervention as this was an open floorplan design. Furthermore, the retrospective design of the present case study did not monitor the number of times a subject may have entered or exited the MSSE space on each shift. Some possible confounders of the present study requiring future research include potential conflicting or additional stimuli occurring outside of the designated MSSE space, which could impact outcomes by increasing or decreasing BPSD. Additionally, biomedical factors were not controlled for the purposes of this study and were not within the scope of the study. Likewise, the design of the study limited the number of total observations for individual residents during the study period, in part because of the nature of the accessible open floorplan MSSE room design. While this has implications for the assessment of individual outcomes, taken as a whole for the residents in the MCAL during the intervention period, the evidence still suggests efficacy for this nonpharmaceutical intervention for BPSD.

In addition, as a natural case experiment, there may be concerns regarding staffing turnover and its impact on measurement, particularly inter-rater reliability. To the extent possible, this risk was mitigated by consistent staff training on study protocols. During the intervention phase, only limited staff turnover was experienced in the 6 months following the installation of the MSSE (four employees), somewhat reducing this potential risk. Additionally, there was some concern that demographic characteristics of staff may play a role in measurement quality. In a study exploring the caregivers' perspectives of BPSD episodes experienced by older adults diagnosed with dementia, findings report that African-American caregivers report less upset and more confidence in managing aggressive behaviors when compared to white caregivers (Hansen, Hodgson and Gitlin, 2018). Different cultures' varying perceptions, as a care provider of residents with dementia, could play a role in the

number of reported, or underreported, BPSD episodes, which would alter the total documented episodes, as conducted in the present study. This, too, was mitigated through training to improve consistency in measurement quality.

Lastly, the homogeneity of the study population suggests the need for further research, as the manifestations of BPSD symptoms and acceptance of MSSE may vary across populations. The study population in this analysis was mostly white, non-Hispanic, which reflected the general community demographics where the MCAL was located. While the installation of the MSSE in the present study showed evidence of improvement in BPSD episodes, other factors such as race, ethnicity, and sex may play a role in usage and response to the MSSE. The likelihood of variations in disease was addressed in a study by Gross et al. (2015), examining the effects of education and race on cognitive decline in older adults, and suggests that while white, non-Hispanic, participants had higher baseline educational scores than African-American and Hispanic participants, race/ethnicity and education do not have a strong effect or act as a major determinant of cognitive decline. The authors state that it is likely that diseases of aging, such as Alzheimer's disease and other progressive dementing illnesses, act as strong determinants of cognitive decline in older adults. Due to patient composition in the MCAL, the present study did not include sufficient diversity to study all potential variations in cognition and BPSD episodes that may coincide with a dementia-related diagnosis.

## CONCLUSIONS

This study shows that an MSSE accessible room design can be created in an existing setting successfully to reduce episodes of BPSD. Additionally, the design was successful in its approach due to the subject population having the ability to independently ambulate within the MCAL unit as well as enter and exit the MSSE voluntarily. In summary, this work builds upon existing research by revealing that an MSSE may positively improve mood and behavior in older adults, but with the added component that the older adult may utilize the MSSE without the need of a care provider to provide direct supervision while the space is in use. We recommend additional studies of the MSSE with an accessible room design for persons diagnosed with dementia in order to add to the evidence-based research needed to continue to support greater adoption of the MSSE's in MCAL settings. Additionally, the length of time studying the MSSE in MCAL settings should be extended to identify the potential long-term impact(s) of the intervention. Furthermore, studying accessible MSSE room designs in locations of varying socioeconomic status, levels of cognitive decline, and caregiver demographics are recommended to determine

how patients of other races and ethnicities are affected by an accessible MSSE room to add to the evidence-based research to expand the generalizability of the intervention.

## ADDITIONAL FILE

The additional file for this article can be found as follows:

- **Dataset:** September 1, 2017 to August 31, 2018. DOI: <https://doi.org/10.31389/jltc.151.s1>

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## COMPETING INTERESTS

The authors have no competing interests to declare.

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