The use of multi-sensory stimulation to improve functional performance in older people with dementia: A randomised single blind trial.

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Abstract

Background: Dementia affects over 750,000 people in the UK [1]. Clinicians and managers report dissatisfaction with current healthcare options available for people with dementia [2]. Multisensory Environments (MSEs) utilising advanced stimulating equipment targeting the senses, have been successfully used with individuals with dementia, with learning disabilities and in palliative care [3]. Despite this, no controlled studies have been conducted to explore the efficacy of this intervention on functional performance.

Research question: To what extent, if any, do MSEs influence functional performance of people with moderate to severe dementia compared with a control activity.

Design: Single blind randomised controlled trial.

Setting: Hospitals and nursing homes in the south of England.

Participants: Thirty people with moderate to severe dementia

Methods: Following baseline assessment to structure the interventions, each participant attended their allocated intervention 3 times a week for 4 weeks. Assessments were carried out before and after each session using the Assessment of Motor and Process Skills (functional performance).

Results: Results revealed significant main effects of the MSE in functional performance. Sessional analysis revealed significant improvement in motor performance for the MSE group. Overall, both MSE and the control activity were found to improve functional performance.

Conclusion: This study supports the use of sensory activity for people with moderate to severe dementia and recommends the use of the Adult Sensory Profile and the PAL Occupational profiling Instrument to plan and facilitate activity.

Key words: Multi-sensory environments, Sensory stimulation, Dementia, Activity

Introduction

Alzheimer's disease, vascular dementia and dementia of other aetiology according to DSM-1V [4] criteria and ICD-10 [5] affects six percent of the European population over age 75 [6]. These progressive disorders present with discrete deficits in cognition, mood, behaviour, and functional ability leading to difficulty with participation in activity [7-9]. Although many non-pharmacological interventions are available to try and manage some of the problems presented by dementia, for example, Reminiscence Therapy and Reality Orientation, clinicians and healthcare managers report difficulties in their facilitation [2]. This failure to provide suitable activity may lead to many patients enduring twelve hour periods of chair sitting punctuated by corridor pacing and food or toilet experiences [10]. Conceivably, these interventions fail due to the effort required by the facilitator to enagage the person with dementia in a suitable activity [11]. Despite the inherent difficulties highlighted, there is a widely held assumption that facilitating activity is still a worthwhile endeavour.

The National Framework for Older People [12] has a 10 year programme to improve services for older people. This programme takes a positive view of old age, encouraging the development and evaluation of innovative practice. One intervention which can be considered innovative is the use of multi-sensory environments (MSE). MSEs contain a variety of equipment to stimulate the senses (sight, sound, touch, taste and smell). Using this equipment, MSEs can offer an activity based intervention which is argued to address imbalances in sensoristasis and levels of sensory stimulation by pacing sensory stimulating activity with sensory calming activity. This may assist people with dementia and their carers in coping with confusion and behaviour changes which are consequences of progressive, debilitating illness [13-15].

As a treatment strategy, multi-sensory environments have been available for people with dementia for the last 20 years and may offer an activity which can be matched to participant skill level. However, the value of this intervention for people with moderate to severe dementia has yet to be established [16] and research into its efficacy is limited. Therefore, this study explores to what extent, if any, MSE influence functional performance of people with moderate to severe dementia.

Method

Research using complex interventions for people with dementia brings challenges in methodological designs that are not always evident with other clinical groups. A randomised single blind design using stratified randomisation was used to evaluate the effect of the interventions on functional performance.

Ethical considerations

This study was approved by Local Research Ethics Committees. Given the relative severity of cognitive impairment of the participants particular emphasis was given to informing them about the study in a way they could understand and ensuring enduring consent was maintained.

Research design

Sample size

Sample size was calculated using two sources of evidence. Firstly, as the study was to be powered to find an effect in either the MSE intervention or in the control group, the baseline mean (*M*) and standard deviation (*SD*) from all pilot participants were used to calculate a sample size sufficient to detect a 0.5 change using the Power and Sample Size Programme (Version 2.1.31) [17]. As the AMPS has two scores (Motor and Process scores) sample size was calculated separately for each, giving 18 and 24 participants per group for Motor and Process respectively, meaning a total *n* of either 36 or 48. Secondly, given the small number of participants in the pilot study, the predicted sample sizes were compared with calculations from other studies using the AMPS assessment [18-20]. As a result, the sample sizes calculated suggested a conservative sample size of 25 participants per group (total n = 50).

Participants

Participants were selected from older people with a clinical diagnosis of moderate to severe dementia who were resident on continuing care wards or in nursing homes within an area of the south of England. The Standardised Mini-Mental State Examination (SMMSE) [21] was used as a measure of overall dementia severity. Individuals scoring between 0 and 17 were suitable for inclusion into the study. This cut off point was chosen to represent people with moderate to severe dementia [22;23]

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Assessment tools

Baseline assessments were conducted to describe the characteristics of the participants and to provide relevant information regarding the construction of the MSE activity and the control activity sessions: SMMSE [21], GBS Scale [24], to identify degree of physical inactivity, intellectual impairment, emotional capacity and mental symptoms; the Adult Sensory Profile (ASP) [25], to identify to which sensory preference a person is oriented; the Pool Activity Level Instrument for Occupational Profiling (PAL) [26], to identify activity profiles for each individual during the MSE or the control group; the Assessment of Motor and Process Skills (AMPS) [27], to establish a baseline level of motor and process skill within functional performance; and the Neurobehavioural Rating Scale (NRS) [28], to establish a baseline level of mood and behaviour problems. The AMPS was used pre and post session over the 12 sessions, in order to monitor changes in functional performance.

Interventions

Each intervention was conducted according to protocols identified by the PAL Instrument for Occupational Profiling (Pool, 2002) to ensure application of the interventions was standardised between participants. These protocols describe the length of time recommended to run the session, presentation of the equipment and the format of the session given the participant's level of functioning.

The multi-sensory environment (MSE) - MSE utilise advanced sensory stimulating equipment that targets the five senses of sight, hearing, touch, taste and smell. Visual (sight) stimulation is achieved using a solar projector that casts themed images, for example, an underwater scene with fish; coloured optic fibres and a bubble tube. Auditory (sound) stimulation is achieved by playing music or environmental themes such as bird song. Tactile (touch) stimulation is accomplished using optic fibres to stroke and plait, and textured fabrics. Gustatory (taste) stimulation is achieved by offering small amounts of citrus fruits, sherbert and textured foods such as popcorn, jelly and so forth. Olfactory (smell) stimulation is achieved by using aromatherapy scents and smell pots (small pots containing everyday aromatic items such as cloves or peppermint). This activity was run in a quiet area, quiet room or purpose built MSE. Each participant was encouraged to interact with equipment based on their results from the PAL assessment and the Adult Sensory Profile.

The control activity (gardening) - As previous research has indicated that activity has a positive effect on people with dementia [23;29], the primary research questions were designed to investigate what were the special qualities of MSEs that might give a positive outcome. Conceivably, it is the unstructured sensory stimulation. Therefore a control activity was selected that had similar sensory qualities as the MSE but a more subtle mode of sensory stimulation and a more structured format. Gardening was chosen as a control for these reasons. This activity was run in a quiet room away from other people. The participant was asked about the type of gardening activity they would like to do. For those who were unable to make a choice, carers and relatives were consulted.

Procedure

After baseline assessments were completed the participant was taken by the key nurse or therapist to their allocated intervention activity (MSE or control). On arrival they were given several minutes to settle before the activity started. Specific details regarding the facilitation method were determined by the PAL assessment. On completion of the activity, the participant was given several minutes to prepare to leave the room. They were then taken by the key nurse or therapist to the researcher for post session assessment.

Results

There were no significant differences between the two groups in age, distribution of gender, of recruitment sites or of diagnosis, in SMMSE, PAL occupational profiling, GBS, or in AMPS scores (Table 1).

Table 1: Demographic and clinical characteristics

		MSE	Control
M(*SD*), range		*n* = 17	*n* = 13
Age (years)		80.00 (7.2), 60 - 91	83.08 (6), 70 - 95
Gender (Male : Female)		7:10	10:3
Recruitment site	Day hospital	4 (23%)	4 (31%)
	Continuing care	6 (35%)	4 (31%)
	Nursing Home	2 (12%)	1 (8%)
	Assessment ward	5 (29%)	4 (31%)
Diagnosis	Alzheimer's disease	13 (77%)	9 (69%)
	Vascular dementia	4 (23%)	3 (23%)
	Lewy Body disease	0 (0%)	1 (8%)
SMMSE		9.53 (5.08), 1 - 17	10.54 (4.61), 4 - 17
Sensory profile	Low registration	6 (35%)	4 (31%)
	Sensation seeking	8 (47%)	3 (23%)
	Sensory sensitive	1 (6%)	4 (31%)
	Sensation avoiding	2 (12%)	2 (15%)
PAL	Planned level	3 (18%)	4 (31%)
	Exploratory level	5 (29%)	4 (31%)
	Sensory level	2 (12%)	4 (31%)
	Reflex level	7 (41%)	1 (8%)
GBS	Intellect	43.88 (12.73), 26 – 62	33.77 (15.49), 11 – 63
	Emotional	7.12 (4.19), 1 – 17	5.15 (4.99), 0 – 17
	ADL	18.82 (12.19), 2 – 40	14.23 (10.86), 0 – 36
(Higher score = more severe impairment)			

Note. SMMSE - Standardised Mini-Mental State Examination, < 14 = moderate to severe dementia; PAL - Pool Activity Levels; GBS - Gottfries Bråne Steen scale; ADL – Activities of Daily Living.

Analysis was complete baseline to last treatment session and baseline to session 6. Analysis for AMPS motor scores revealed a significant main effect of intervention, F (1,27) = 8.63, p = .007. There was no significant interaction, F < 1, that is the intervention did not affect the groups differently, and no main effect of group, F < 1. Analysis for AMPS process scores revealed a significant main effect of intervention, F (1,27) = 4.56, p = .042. Again, no significant interaction, F < 1, and no main effect of group, F < 1 were found.

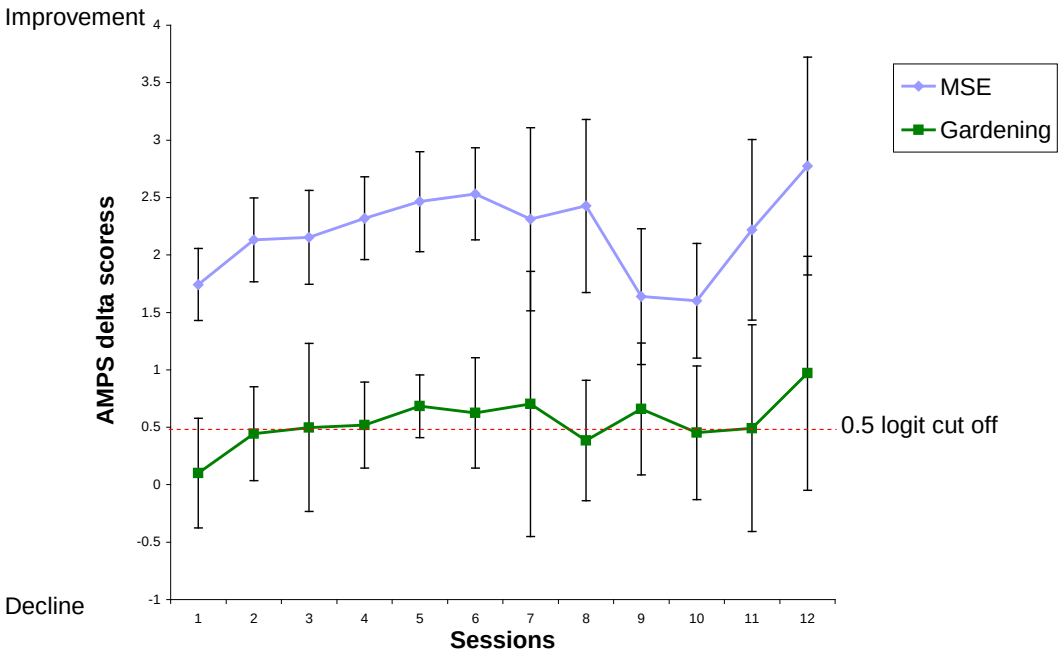
The number of participants who improved from baseline (session 1) to session 6 on the AMPS motor assessment revealed a significant main effect of intervention, F (1,19) = 9.67, p < .006. There was a significant interaction between intervention type and group, F (1,19) = 7.07, p = .016, but there was no main effect of group, F < 1. The interaction term was decomposed to check where the intervention effect occurred. A significant effect of intervention was found for the MSE group from baseline to session 6, t (11) = -5.8, p < .001, even adjusting for multiple testing, but not for the control group, t (8) = -0.2, p = .816. Furthermore, there were no differences between groups at baseline, t (28) = -0.5, p = .641 or at session 6, t (19) = 0.8, p = .443.

This analysis was repeated for AMPS process scores. There was no significant main effect of intervention, (1, 19) = 3.76, p = .069. There was a significant interaction, F (1,19) = 11.90, p < .003 , but there was no main effect of group, F < 1.

Sessional analysis

To explore the effect of each session on AMPS motor scores the mean change (delta) scores across participants was calculated for each session, for each intervention. A positive score indicates an improvement in motor performance. A delta score greater than or equal to +0.5 logits indicates significant improvement. Figure 1 shows mean delta scores over the 12 sessions for the two interventions.

Figure 1: Mean delta AMPS motor scores over 12 sessions for treatment groups

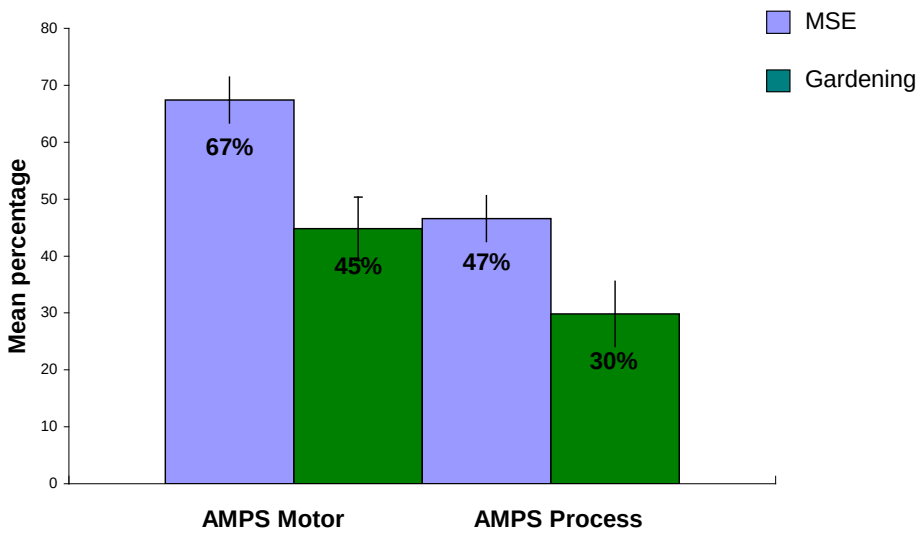


Note. Error bars = 95% Confidence intervals. Different numbers of participants are entered into the mean score recorded for each session.

The majority of MSE participants improved by 0.5 logits or more after each session. Improvements amongst the control group were more variable and closer to the 0.5 logit cut-off with only three overlapping confidence intervals (CI) between the two groups. The results for the AMPS process scores were more variable.

Next, the effect of the interventions over a period of sessions was explored by examining the mean percentage sessions in which a participant improved. Figure 2 shows the mean percentage of sessions for which an improvement in motor and process skills, ≥ 0.5, was achieved in each group.

Figure 2: Percentage of sessions for which a participant made an improvement ≥ 0.5 logits in AMPS motor and process scores



Note. Error bars = Standard errors of mean percentages.

A t-test was used to explore group differences in the percentage of sessions for which an improvement was made. There were significantly more sessions in which improvement was made in motor performance in the MSE group (M = 67.39, SD = 24.61) compared with the control group (M = 44.80, SD = 29.66), t (28) = 2.28, p = .030. There was no statistical difference between the MSE (M = 46.55, SD = 24.64) and control group (M = 29.82, SD = 30.63) for process scores, t (28) = 1.66, p = .108.

Discussion

The analysis of AMPS scores from baseline to last treatment session revealed a significant improvement in motor and process scores for both groups. Analysis of AMPS scores from baseline to sessions 6 revealed a significant improvement in motor and process scores for the MSE group only. Analysis of AMPS delta scores for individual sessions revealed that all participants in the MSE group significantly improved in motor skills whereas just over half of the participants in the control group significantly improved in motor skills. Analysis of the number of sessions for which an improvement was made revealed that there were significantly more sessions for which improvement in motor skills was made in the MSE group, compared with the control group. There was no significant difference between groups for process skills.

The results for process skills, which include cognition, are unsurprising as an improvement in this area was considered to be unlikely given the normal rate of decline [30]. However, motor skills did improve in both groups, often to a greater extent in the MSE group. As motor skills are essential for participation in daily life, this outcome may benefit other activities of daily living such as self care and feeding. The association between maintenance of motor skill and activity performance was explored by Kolanowski [31] who found that people who are physically frail take part in less activity. Although the causal association between physical ability and activity remains unclear, these results are also consistent with the findings of a number of other correlation studies [32-34], all of which have shown a relationship between motor performance and participation.

As people age they show a decline in sensory acuity which is exacerbated by a decline in perception, attention and information processing [35]. Despite this decline motor learning remains intact in people with Alzheimer's disease, suggesting preservation of neural structures that integrate sensory and kinaesthetic information. Therefore, loss of motor performance seen in moderate to severe dementia may not be due to neural damage, but rather to the cognitive deficits which create 'noise' within the central nervous system. This 'noise' is thought to impede sensory processing and motor response [36].

Stimulus enhancement may also assist in sensory processing. An environment offering weakened proximal stimuli may contribute to the confusion experienced by the person with dementia, thereby leading to an increase in cognitive and behavioural impairments [37]. By enhancing the sensory signal the demand on the CNS is reduced and performance may be enhanced. Multi-sensory environments may be modified to control the number of competing stimuli and the intensity of stimulation by matching sensory preferences to individual need. This suggestion is consistent with the findings of Cronin-Golomb, Gilmore & Morrison et al. [38], Dunne, Neargarder & Cipolloni et al. [39] and Kovach [15], who demonstrated an increase in performance by enhancing the stimulus presentation to match the information processing ability of the individual.

Therefore, by modifying the level of sensory stimulation presented in the MSE, and facilitating participation to accommodate problems in perception, attention and information processing using the PAL activity profiling tool, it may be possible to reduce cognitive 'noise' and improve the person's ability to process sensory information by reducing sensory overload. The control activity (gardening) may also be modified to take into account perceptual and cognitive limitations but it is harder to modify the level of sensory stimulation in the same way as the MSE. These limitations may reflect the lower performance scores achieved by the control group.

This study supports the use of activity for people with moderate to severe dementia who are particularly difficult to engage in activity and, secondly, recommends the use of the Adult Sensory Profile and the PAL Occupational profiling Instrument to plan and facilitate activity.
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Key Points

- People with moderate to severe dementia present with discrete deficits in cognition, mood, behaviour, and functional ability leading to difficulty with participation in activity.
- Although many non-pharmacological interventions are available to try and manage some of the problems presented by dementia, for example, Reminiscence Therapy and Reality Orientation, clinicians and healthcare managers report difficulties in their facilitation.
- Engagement in MSEs using the ASP and PAL to plan and facilitate activity, may improve functional performance.
- MSEs may improve functional performance due to improved sensory processing by modifying competing sensory stimuli.

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Conflicts

None of the authors have any declaration of conflict of interest with respect to any products used in this study or referred to in this article.

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