

Tolerability and Acceptability of a Train Travel Simulator in Institutionalized Subjects with Neurocognitive Disorders, The Gran-Via Travel Therapy Project

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Non-pharmacological therapies encompass all strategies aimed at improving quality of life or reducing behavioral symptoms such as depression, apathy, wandering, sleep disturbances, agitation, and aggression in individuals with Alzheimer's disease or related disorders (ADRD). Travel therapy is one such approach. Based on a concept that originated in Italy, one study suggests it can reduce the use of psychotropic medication by 40% and wandering behavior by 30%.

In order to implement this therapy in our hospital, we collaborated with the company SIGO to design a replica train compartment integrated into a setting that reproduces a train station platform. Patients with ADRD, accompanied by a caregiver, can thus experience a virtual train journey via a video projection simulating passing landscapes seen through a train window.



Method

This was a prospective pilot study designed to assess the acceptability of the device used during workshops featuring travel therapy in elderly patients with ADRD. The study took place over a six-month period starting in May 2019.

A caregiver completed a questionnaire assessing both the acceptability of the intervention and the patient's psychological state at the end of each session. Participants were recruited from USLD (long-term care units), EHPAD (nursing homes), and UCC (cognitive-behavioral care units) facilities at the study site.

Results

Forty-two subjects took part in 1 to 3 sessions, and data from 48 sessions were analyzed. The study population included 27 women (64%) and 15 men, with a mean age of 81.6 ± 7.4 years.

While only 58.3% of the participants appeared relaxed before the session, this number rose to 83.3% during the session and 87.5% at the end of the virtual journey. This improvement was statistically significant (see Figure 1). Adherence to the scenario was observed in 79.2% of the participants. Among those who did not engage with the scenario, half still completed the session in a calm state, and only one remained anxious. There was only one dropout, a patient who did not complete the session due to repeated wandering. This individual may have experienced claustrophobia, as they also appeared uncomfortable in elevators.

Memory recall occurred in 50% of participants—either induced (27.1%) or spontaneous (22.3%).

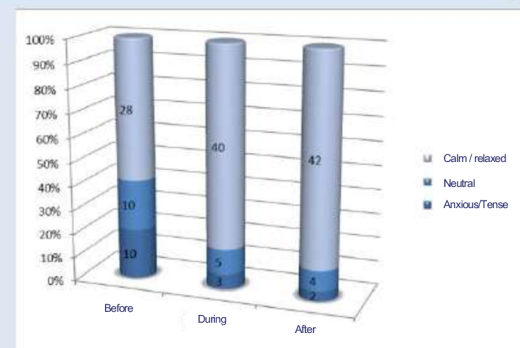


Fig. 1 : Changes in the patients' psychological state:

This study is the first to report findings on the feasibility and acceptability of a travel therapy tool developed by SIGO, which won an innovation award for this project. The majority of participants responded positively to the virtual travel experience.

This pilot study opens new avenues to demonstrate that travel therapy can significantly reduce anxiety and abnormal motor behaviors in patients with ADRD.

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Neuropsychiatric symptoms can disrupt the lives of patients and their families and may lead to a worsening of cognitive deficits. These neuropsychiatric symptoms, also referred to as Behavioral and Psychological Symptoms of Dementia (BPSD), may be associated with Alzheimer's disease and Parkinson's disease. These symptoms can be assessed using the Neuropsychiatric Inventory (NPI).

Nine residents of the Firmin Dieu nursing home (Villers-Bretonneux, 80800) were selected for this study. Due to the absence of two female residents during one of the sessions—resulting in unusable data—these participants had to discontinue their involvement in the research. Thus, the final study sample included seven residents:

- Mrs. W, 85 years old, diagnosed with moderate-stage Parkinson's-type dementia,
- Mr. D, 79 years old, diagnosed with moderate-stage Parkinson's-type dementia,
- Mr. M, 87 years old, diagnosed with severe-stage Alzheimer's-type dementia,
- Mrs. M, 94 years old, diagnosed with severe-stage Alzheimer's-type dementia
- Mrs. P, 92 years old, presenting with severe cognitive impairment without a formal diagnosis,
- Mrs. D, 83 years old, presenting with severe cognitive impairment without a formal diagnosis,
- Mrs. G, 91 years old, presenting with severe cognitive impairment without a formal diagnosis.

The evaluation of neuropsychiatric symptoms was conducted using the Neuropsychiatric Inventory – Nursing Home Version (NPI-NH; Sisco et al., 2000). This is a proxy questionnaire that assesses neuropsychiatric symptoms in patients with dementia through structured interviews with members of the care team. The symptoms are grouped into 12 domains. For each domain, caregivers are asked whether the patient exhibits the symptom, how frequently it occurs (Less than once a week; Once a week; Several times a week; Daily), and its severity (Mild; Moderate; Severe). Sub-questions within each domain were not considered in this study.

The results show a reduction in neuropsychiatric symptoms in all seven residents after the implementation of the train activity, with some individuals showing a notable decrease of more than 10 points, particularly in the domains of agitation, depression, apathy, and agitation. A more in-depth study with a larger sample size is planned for next year.

1 Sisco, F., Taurel, M., Lafont, V., Bertogliati, C., Baudu, C., Giordana, J.Y., ... Robert, P. (2000). Behavioral disorders in institutionalized patients with dementia: assessment based on the Neuropsychiatric Inventory.



Evaluation of a rail-travel simulator for elderly adults with cognitive disorders. The Grand-Via Project, a travel therapy pilot study

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ABSTRACT

Background and purpose: Travel therapy can reduce anxiety symptoms in elderly adults with cognitive disorders. The objective of this pilot study was to evaluate the use of a rail-travel simulator in this purpose.

Materials and methods: The study was a prospective, single centre cohort survey. Our study population consisted of persons either from the nursing home, the cognitive and behavioural unit or the day-care centre of our university hospital. Participants were accompanied on a virtual trip using a film projection in a replica of train compartment. Participants were interviewed before and after each session using a short questionnaire developed by a multi-disciplinary team.

Results: Forty-two participants performed sessions. While only 58.3% of the participants reported being relaxed before the session, this rate increased significantly to 87.5% by the end of the trip. A majority of participants gave their personal impressions and half of the group reported memories evoked by the experience.

Conclusion: The majority of elderly persons who completed the virtual trip replied positively about the experience. We need now to confirm the efficacy of our simulator using a randomised controlled trial.

1. Introduction

Nonpharmacological treatments for elderly persons with Alzheimer's disease or related disorders (ADRD) include any strategy that improves quality of life or reduces behavioural symptoms such as apathy, wandering, agitation and opposition [1,2]. Travel therapy is an umbrella term covering nonpharmacological approaches using travel in a therapeutic manner. Indeed, travel is often seen as a leisure activity but we should not forget that it could assist in improving psychological disorders and become a genuine therapeutic activity *per se*. Limited empirical findings are available but demonstrate the contribution of travel to an individual's perceived health and psychological well-being [3]. However, the rationale for the role that travel therapy may play in ADRD remains limited. One explanation for this effect may be that patients with ADRD present behavioural disorders that are mainly connected to the perception of being confined inside a restricted space or a prisoner of their own disorders. Due to the difficulty of accepting their state of health, they can benefit from an environment that, whether real

or virtual, opens up space and gives them back their freedom inducing a relaxed state of mind and reducing behavioural problems [4,5]. The idea of a rail-travel simulator based on these observations emerged in Italy and was proposed by Cilesi et al., in 2011 [6]. These authors proposed a "Train Therapy" which consists of staging a real trip in a replica of train compartment in order to offer travel therapy within reproducible and controlled settings.

We wanted to attempt this promising therapy in our hospital and to provide naturalistic social situations within this familiar setting. We therefore participated in the development of a rail-travel simulator prototype with the goal of reducing anxiety and other symptoms in elderly persons with ADRD.

The objective of this paper is to present the results of a pilot study testing the feasibility and acceptability of our rail-travel simulator tool in elderly adults with ADRD.

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2. Materials and methods

2.1. Study design and setting

The study was a prospective, single centre, community-based cohort survey. We adopted a *Living-Lab* design approach [7], based on involving all stakeholders (patients, physicians, psychomotor therapists and engineers) in the design process to produce an appropriate therapeutic tool.

We collaborated with the SIGO Healthcare Company who designed a replica of a train compartment integrated in a station platform environment. It is thus possible to make a virtual trip using a film projection simulating the landscape flow during a train trip by means of a large Liquid Crystal Display (LCD) monitor mimicking a train carriage window (Fig. 1).

Train therapy sessions were organised according to the onset of disorders and followed a defined protocol. Participants were accompanied by a health professional (psychomotor therapist, psychologist or specialized care assistant) in the compartment. The trip was announced and the way to the compartment was a carefully prepared ritual: participants were invited to put on their coats, to discuss the destination they wanted to go, and sometimes even to carry a small item of luggage, in order to enter as much as possible into the illusion of a real and imminent trip. The health professional was seated inside the compartment with one or two participants for the entire virtual trip that lasts a maximum of 20 min (Fig. 2). The LCD monitor showed a realistic sequence of a 10 min video of a local train trip viewed from a window compartment, from one station to next. The end of the session was marked by the arrival of the virtual train in the station.

2.2. Sample and sampling method

Our study population consisted of persons either from the nursing

home, the cognitive and behavioural unit or the day-care centre of our university hospital. They were included if they had a history of neuro-cognitive disorder whatever the severity. Each of them, regardless of their condition, carried out 1 to a maximum of 3 sessions at the rate of one session per week.

Residents were excluded if their health and/or motor abilities were incompatible with the procedure or if they refused consent for participation. The recruitment of the participants was conducted on the occasion of nursing staff meetings during which the status of each resident was assessed to evaluate the potential benefit of the treatment.

As this was a pilot study testing the feasibility and acceptability of our rail-travel simulator, no primary endpoint was predicted to define a required number of subjects.

2.3. Measurement instruments

At the conclusion of each session, a structured interview was completed by the health professional using a short questionnaire developed by a multi-disciplinary team including geriatricians, psychologists and psychomotor therapists.

The questionnaire comprised closed questions about the behaviour of the person before, during and after the accompaniment (calm/relaxed, neutral or anxious/tense), about the level of engagement in the trip simulation, on the expression of verbal and non-verbal emotions and possibly memories evoked during the session.

2.4. Data collection

Participants' characteristics were obtained from medical files, including age, sex, living place, type of neurocognitive disorder and presence and type of psychological disorders; before the administration of the questionnaire.





Fig. 2. Interior view of the train prototype.

2.5. Data analysis

For the presentation of results, continuous variables were expressed as mean (standard deviation SD) or median (interquartile range), and qualitative variables as percentages. Fisher's exact test was used for comparisons between qualitative variables. Significance was set at $p < 0.05$. The StatView software suite version 5.0.1 (SAS Inc., Cary, NC, USA) was used for all analyses.

2.6. Ethical considerations

The study did not restrict the usual care delivered to these residents and was approved by the appropriate authorities of our university hospital. All residents provided oral consent in accordance with the guidelines of the local hospital ethics committee.

3. Results

The study ran for six months, from April to September 2019. Over this period, 42 participants performed from one to 3 sessions: 37 participants performed one session, 4 participants two and only 1 subject all three. Overall, we obtained data for 48 sessions.

The sample comprised 15 males and 27 females between the ages of 63–98 years (81.6 ± 7.4). The majority of these persons were nursing home residents (22 residents; 52%) most of whom suffered from Alzheimer's disease (20 persons; 47.6%). While 40.5% had no psycho-behavioural disorders, one-third were frequently agitated and shouting with one-third wandering. The characteristics of the study population at inclusion are presented on Table 1.

While only 58.3% of the participants were relaxed before the session, this rate increased significantly to 83.3% during the session and 87.5% at the end of the trip ($p < 0.02$).

The adhesion rate was 79.2%. Among the participants not adhering to the simulation of a trip, half ended up nevertheless feeling relaxed with only one remaining anxious. Only one participant failed to finish the session. This person repeatedly attempted to exit the compartment and appeared claustrophobic as shown by anxiety when in a lift. In this situation, the trip was interrupted and the resident escorted back to his

Table 1

Characteristics of the study population (n = 42) at inclusion.

Age in years, mean (\pm standard deviation)	81.6 (\pm 7.4)
Sex (Female), number (percent)	24 (64.0)
From, number (percent):	
- Cognitive & behavioural unit	22 (52.0)
- Day-care centre	19 (45.0)
- Nursing home	1 (2.0)
Type of neurocognitive disorder, number (percent):	
- Alzheimer's disease	20 (47.6)
- Vascular dementia	5 (11.9)
- Both types of dementia	9 (21.4)
- Frontal-temporal disease	4 (9.5)
- Parkinson's disease	4 (9.5)
Type of psycho-behavioural disorders, number (percent):	
- Wandering	13 (31.0)
- Agitation and yelling	14 (33.3)
- Opposition	2 (4.8)
- Hallucination and delusion	5 (11.9)
- Anxiety and depression	4 (9.5)
- No disorder	17 (40.5)

room, to ensure full recovery from the stressful experience.

A majority of participants expressed their feelings about the experience. Comments about the compartment itself were generally positive: the participants appreciated the comfort of the armchairs, the decoration and the interior design that produced a feeling of well-being for a comfortable and soothing trip. Concerning the adhesion to the realism of the simulation, although some pointed out that they were aware that this was a simulated train and talked about "monitor" and "movies", overall, they found the experience realistic and enjoyable. They watched the screen, being more or less captivated, and described what they saw in the scrolling video.

Half of the group reported memories evoked by the experience, which was the source of many discussions during the trip: some described their emotions, others shared reminiscences as memories came to the surface. Several passengers attended to the sounds (train wheels on the rails), to the animals seen (cows, birds) and were even moved and touched by certain noises (Departure announcements on the

public address system): "I loved getting on trains when I was young" "I've always been thrilled to go by train" "I remember travelling by train in the mountains when I was 18" "I used to take trains since my husband worked for the railway company". For one subject, it was the first ever experience of such a trip having never had the opportunity to travel by train. Forty-five percent of the participants also expressed emotions. Most of them expressed a sense of peace and relaxation. Some negative features however were expressed. Two participants found the session monotonous with a lack of landscape diversity during the trip. Another said spontaneously "it hurts the eyes" in front of the scrolling video. At the end of the session one subject, getting out from the virtual train, already wished to take the train back to where he came from, another needed to be reoriented in time and space.

4. Discussion

This study is the first to present results on feasibility and acceptability of a tool dedicated to travel therapy for these patients. Indeed, there is no recent literature on this original and innovative treatment for the care of elderly persons with ADRD. The idea emerged from promising data on therapeutic holidays frequently suggested in the medical literature. Indeed, some studies have reported on experiences gained with short trips or excursions for chronic psychiatric patients [8–12]. Nothing new was published after these pilot studies which, although limited by their small size, lack blind controls and comparison with a relatively uncontrolled normal care condition, were able to show that these trips have a beneficial effect on the patients' mental status, improve the image of in-patient psychiatric treatment and may represent an enrichment of the overall therapeutic programme [13].

Older persons, however, are less mobile because of motor and functional deficiencies, often due to underlying neurocognitive disorders. Travel therapy would initially appear very hard to implement in an institutional setting. However, virtual reality technology allows harmless and convenient immersion in the travel experience from which an elderly patient can safely profit.

Cilesi and his team [6] were the first to propose a rail-travel simulator which consisted of staging a virtual trip in a train compartment. They recreated the experience of a compartment of train by placing, side by side, two pairs of armchairs and building an LCD monitor into a wall to provide a virtual window playing video footage filmed from real moving trains. A limitation of their therapeutic rail-travel simulator was that an entire room had to be dedicated to the project. They also have not been able, apart from a presentation of the prototype, to publish results obtained by a reliable and statistically significant technique, and, as a result, no data exists on the evaluation of this technology in this specific population for ADRD. In our study, the aim was to determine whether a rail-travel simulator could be created, that would be feasible, realistic and well tolerated by the participants.

We found that the majority of persons performing the virtual trip gave positive feedback on the experience. They perceived the virtual train environment as a safe place and happily accepted to enter the compartment and be seated. A small number nevertheless expressed negative perceptions of the experiment but even these participants were significantly more relaxed after the virtual trip.

The idea of recreating a train trip works well with the travel therapy project but may also be related to Reminiscence Therapy (RT) [14]. In the context of ADRD, RT may represent a possible effective non-pharmacological therapy [15]. Clearly train travel was a common experience in the earlier years of the elderly population and can trigger memories and thus be a good mediator for RT: enabling the arousal of the senses of sight, hearing, and touch to trigger discussion of long-term memories and the creation of a relaxing environment.

In our study, participants showed a reduction of anxiety and of aberrant motor behaviours during and after the sessions. This indicates that our rail-travel simulator fulfilled its mission by avoiding the creation of an anxiety provoking environment that would limit improvement

or even aggravate it.

We acknowledge that the conclusions of our study are limited by the sample size and the methodology employed. The lack of literature on this topic was a problem for this quantitative research as there was no empirical or theoretical basis for performing a controlled trial but as a pilot study, it has yielded encouraging preliminary results. Some limitations cannot be controlled for but we tried to minimize the majority of them by finding an appropriate balance between scientific rigor and realism. We created the questionnaire to evaluate the feasibility and acceptability of our tool as no validated questionnaire existed to match our needs. This tool was not validated but it was constructed by a multi-disciplinary team possessing extensive experience in the care of this elderly population. This may represent a limitation but, since we were in a pilot study, our priority was to test the feasibility and acceptability of our rail-travel simulator when used by elderly persons with ADRD. We have nevertheless shown that the use of travel therapy can offer the potential for an acceptable and safe technique for this population if used in a controlled and well-designed manner.

5. Conclusion

This pilot study has shown the good feasibility and acceptability of our rail-travel simulator to conduct travel therapy for elderly adults with ADRD. Whilst results concerning improvements of behavioural symptoms and anxiety were encouraging, the limitations call for vigilance in their interpretation. However, this study is paving the way for a full evaluation study. With this rail-travel simulator prototype deployed in our hospital, we will continue to investigate the efficacy of this method of travel therapy using a randomised and controlled trial protocol. The main objective will be a significant reduction of anxiety and aberrant motor behaviours evaluated with validated scales in comparison to controls using drugs or other nonpharmacological treatments.

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Conflicts of interest/Competing interests

F. Bloch, S. Boutalha, I. Defouilloy and F. Couvillers-Dek declare no conflict of interest. JC. Froment is co-founder and CEO of SIGO Healthcare Company, J. Ernecq is co-founder and associate of SIGO Healthcare Company.

Availability of data and material

Derived data supporting the findings of this study and copy of the questionnaire (French version) are available from the corresponding author [FB] on request.

Authors' contributions

JC. Froment: Creation of the prototype; **J. Ernecq:** Creation of the prototype; Methodology, Investigation; **F. Bloch:** Conceptualization, Methodology, Investigation, Data Curation, Writing- Original Draft Preparation, Supervision; **F. Couvillers-Dek:** Methodology, Investigation; **I. Defouilloy:** Investigation, Writing, Reviewing; **S. Boutalha:** Investigation, Reviewing.

Ethical considerations

The Grand-Via Project was co-granted by the university Picardie-Jules-Verne and the Amiens-Picardie University Hospital. It was validated by the Research Projects Evaluation Commission of the geriatric committee the 28th of January 2019 (N° COPIL190128-004).

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