Activitas Nervosa Superior Rediviva Volume 68 No. 1 2026

ORIGINAL ARTICLE

DOI: https://doi.org/10.31577/ansr.2026.68.1.4

Virtual Reality for Cognitive Support in a Person with Alzheimer's Disease: A Single-Case ABAB Feasibility Study

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Submitted: 2026-03-17 Accepted: 2026-04-25 Published online: 2026-04-25

Key words: **cognitive training; dementia; virtual reality; single-case experimental design**

Act Nerv Super Rediviva 2026; **68**(1): 40–48 68012604

Abstract

OBJECTIVE: This preliminary study examined the feasibility of a virtual reality-based intervention and explored phase-related changes in selected cognitive functions in a person with dementia due to Alzheimer's disease. The intervention was delivered as a supplement to existing services in a social care facility.

METHODS: A single-case ABAB withdrawal design (N = 1) was conducted across 12 months (January-December 2025). Phase A represented periods without the experimental intervention, and phase B represented periods in which the participant underwent structured VR-based sessions three times per week for approximately 50 minutes per session using a commercially available Meta Quest head-mounted display. Repeated assessment was conducted monthly using the Addenbrooke's Cognitive Examination (ACE). Data were analyzed using descriptive and visual methods, supplemented by the Percentage of Non-overlapping Data (PND) and the Reliable Change Index (RCI). Because the initial A1 baseline phase included only two monthly data points, baseline stability was interpreted cautiously and the study was framed as a feasibility-oriented preliminary single-case investigation rather than as evidence of efficacy.

RESULTS: Performance in the monitored cognitive subdomains showed a phase-related pattern. During the intervention phases, attention/orientation scores increased from 11 to a peak of 13 points, and memory scores increased from 16 to a peak of 18 points; both domains declined during the withdrawal phase (July–August). PND values ranged from 25 % to 75 % across phases and domains. Neither RCI value (1.56; 0.99) exceeded the threshold for statistically reliable individual change (>1.96). The two initial A1 measurements were identical, but the short baseline prevents robust inference regarding baseline stability. These preliminary findings suggest that the intervention may be associated with favorable phase-related changes in selected cognitive functions, although the single-case design precludes definitive conclusions regarding efficacy.

CONCLUSION: The VR-based intervention was acceptable and implementable within routine social care and was associated with phase-related changes in selected cognitive functions. These preliminary findings do not permit causal conclusions or generalization, but they support the feasibility of conducting a larger main study using this intervention format.

Introduction

Virtual reality is currently regarded as one of the most promising technologies for the non-pharmacological support of people with dementia, as it enables the integration of cognitive training, motor activation, practice of everyday activities, and emotionally meaningful reminiscence stimuli within a safe and controlled environment. Its major advantage lies in the possibility of creating ecologically valid situations that closely resemble real-life daily functioning, while at the same time allowing the level of difficulty, duration, and sensory load to be adapted to the current abilities of a particular individual. Existing review studies suggest that virtual reality may support cognitive performance, motor functioning, engagement in activities, and positive emotional experience in older adults with cognitive impairment, although findings are not entirely consistent and vary according to the type of intervention and the degree of immersion (Ren *et al.* 2024; Yu *et al.* 2024; Stavropoulou *et al.* 2025; Sohrabei *et al.* 2025; Kubota *et al.* 2026). A substantial part of the recent literature indicates that VR interventions may have beneficial effects particularly on global cognition, attention, processing speed, executive functions, and, in some studies, also on quality of life and performance in instrumental activities of daily living. However, meta-analyses and systematic reviews also show that more robust evidence has so far been obtained more frequently in individuals with mild cognitive impairment or cognitive frailty, whereas the evidence for people with manifest dementia remains more limited. For this reason, optimistic conclusions should not be adopted uncritically; rather, attention should be paid to which effects are genuinely transferable to people with dementia and under what conditions they may have practical relevance in clinical or social care settings (Zhong *et al.* 2021; Yang *et al.* 2025; Li *et al.* 2025; Santos *et al.* 2025; Sasaninezhad *et al.* 2024; Kwan *et al.* 2024).

For people with dementia, interventions aimed at managing behavioural and psychological symptoms of dementia, reducing apathy, promoting activity in institutional care, immersive reminiscence, or training instrumental activities of daily living appear particularly promising. Pilot and randomized studies suggest that VR is generally well tolerated, may increase engagement in activities, and in some cases may contribute to improved mood, reduced aggressive behaviour, or greater motivation to participate. Positive outcomes have also been reported for VR exergaming and motor-cognitive programmes that combine physical and cognitive demands and thus reflect the complex nature of functional decline in neurodegenerative conditions (Appel *et al.* 2021; Appel *et al.* 2024; Clay *et al.* 2024; Shin *et al.* 2023; Saredakis *et al.* 2020; Huang & Yang 2022; Chan *et al.* 2024; Voinescu *et al.* 2024). At the same time, it must be emphasized that research in this field is still burdened by considerable heterogeneity in the technologies used, the duration and intensity of programmes, small sample sizes, short follow-up periods, and differing outcome measures. Important questions also remain unresolved regarding the long-term sustainability of effects, the optimal degree of immersion, safety in frail patients, and the actual feasibility of implementation in routine care. Virtual reality should therefore not be understood as a standalone solution, but rather as an innovative and potentially highly effective complement to comprehensive training for people with dementia. Against this background, the present study used a single-case ABAB design to examine whether a VR-based intervention can support cognitive functioning in a person with Alzheimer's disease in a real-world social care setting, serving as a procedural foundation for a planned larger study. Recent research also suggests that the value of virtual reality in dementia care should not be reduced to cognitive outcomes alone. In long-term care settings, VR appears to address important psychosocial needs by offering meaningful experiences, supporting continuity of self and personal identity, fostering social connection, involving family members, and providing comfort through pleasant and emotionally resonant virtual environments. In addition, exploratory immersive applications may stimulate autobiographical recall and combine cognitive and motor engagement without compromising safety. These findings indicate that VR may be particularly valuable when it is designed as a person-centred intervention that supports well-being, engagement, and lived experience rather than functioning solely as a narrowly defined cognitive exercise (Wong *et al.* 2025; Eckert *et al.* 2025).

At the same time, recent evidence highlights that the successful use of VR in older adults with dementia depends not only on therapeutic content, but also on careful design and implementation. Age-related sensory, motor, and cognitive changes may reduce usability and increase disorientation or discomfort if applications are not adapted appropriately. Accordingly, simplified controls, self-paced interaction, adjusted audiovisual input, and structured familiarisation are recommended to improve accessibility and reduce cognitive load. Feasibility studies further show that even brief immersive sessions can be acceptable in acute hospital settings, while implementation research in long-term care emphasizes the importance of organizational support, sufficient space, staff confidence, troubleshooting capacity, and person-centred delivery. These considerations are especially relevant for future intervention studies, which should evaluate not only efficacy, but also tolerability, usability, and implementation readiness in real-world care environments (Schaumburg *et al.* 2025; Montgomery *et al.* 2025; Sadowski *et al.* 2026).

The present study is positioned within this literature primarily as a methodological and implementation-oriented feasibility study rather than as a defini-

tive efficacy trial. Previous VR studies in dementia and cognitive impairment have most often focused on short-term feasibility, symptom management, reminiscence, exergaming, instrumental activities of daily living, or group-level pre-post and randomized comparisons (Appel *et al.* 2021; Appel *et al.* 2024; Saredakis *et al.* 2020; Shin *et al.* 2023; Clay *et al.* 2024; Prinz *et al.* 2024). In contrast, the present work follows one participant with Alzheimer's disease over a full 12-month period in a social-care facility and applies an ABAB withdrawal structure with monthly ACE assessments, visual single-case interpretation, PND, and RCI. Its distinctive contribution therefore lies in testing whether a repeated-measure, phase-based VR protocol can be implemented in routine long-term social care and whether such a design can generate sufficiently interpretable data for a subsequent main study. The study is consequently intended to strengthen procedural knowledge, feasibility assessment, and future trial design, rather than to claim generalizable intervention efficacy from a single case.

Methodology

Aim

The aim of this preliminary study was to examine the feasibility of a virtual reality-based intervention and to explore phase-related changes in cognitive functioning in a selected participant with dementia using a single-case ABAB research design. The study also served to verify the suitability of the proposed procedures prior to the implementation of the main study. The therapy was provided as a supplement to existing services at a social services facility.

Research Sample

The research sample consisted of one intentionally selected participant (N = 1) included in a preliminary single-case study. The participant was recruited from a social services facility in which the intervention was implemented as a supplement to the standard care routinely provided by the institution. The participant was not included in either the experimental group or the control group of the subsequent main study, as the purpose of the preliminary phase was to verify the feasibility, suitability, and practical applicability of the proposed intervention procedures prior to the full-scale research implementation. The participant had been diagnosed with dementia due to Alzheimer's disease (according to ICD-11) 1.5 years prior to the initial examination, conducted at the family's recommendation due to worsening memory, disorientation, and observable behavioral changes. No contraindications to VR use were identified, and the participant tolerated the headset without reported discomfort or adverse response. Selection of the participant was based on predefined inclusion criteria established in advance with regard to the objectives of the study and the specific nature of the virtual reality-based intervention. The participant had a clinically confirmed diagnosis of dementia and presented with cognitive decline of a degree that still allowed repeated participation in the intervention programme and follow-up assessment. Only an individual who was able to cooperate with the research team, tolerate repeated testing, and engage in structured therapeutic sessions was considered eligible for inclusion. At the same time, the participant's health status had to be sufficiently stable to allow repeated attendance at intervention sessions throughout the monitored period. The inclusion criteria therefore comprised the presence of dementia-related cognitive impairment, the ability to understand and follow simple instructions, the capacity to participate in repeated sessions of approximately 50 minutes, and the absence of any acute condition that would make participation unsafe or unreliable. Consideration was also given to the participant's functional status and overall adaptability to the care environment, as the intervention was designed not only to stimulate cognitive functioning but also to respect the participant's individual needs, current level of performance, and tolerance of the applied procedures. This individualized approach was essential because the preliminary study aimed to examine the responsiveness of the selected participant to the intervention under real-life care conditions. The exclusion criteria included acute deterioration of physical or mental health, severe behavioural instability, significant communication barriers, or any serious sensory, neurological, psychiatric, or somatic condition that could prevent safe and meaningful participation in the intervention or repeated assessment. In particular, special attention was paid to conditions that might interfere with the use of virtual reality, such as pronounced disorientation, severe visual or auditory deficits, marked intolerance of new stimuli, or inability to remain engaged in the intervention setting for the required duration. The exclusion criteria were formulated to reduce the risk of burdening the participant and to ensure that any observed changes could be interpreted in relation to the intervention itself rather than to acute health complications or non-specific barriers to participation. From a methodological perspective, the use of a single participant was consistent with the selected single-case research design. This approach allowed for detailed and repeated observation of the participant across alternating intervention and non-intervention phases and enabled the researchers to evaluate the practical functioning of the ABAB design under authentic care conditions. Rather than seeking immediate generalizability, this preliminary stage focused on obtaining an in-depth understanding of the participant's response to the intervention, identifying possible ambiguities in the procedure, and refining the intervention protocol for later use in the main study. In this respect, the research sample fulfilled an exploratory and developmental

Tab. 1. Summary of the VR intervention protocol

Protocol element	Description used in the preliminary study
Hardware	Commercially available Meta Quest head-mounted display; seated use under continuous supervision.
Setting	Quiet, familiar room in the social-care facility; supplementary to standard care.
Frequency/duration	Three sessions per week during B phases; approximately 50 minutes including pauses and debriefing.
Session structure	Orientation and headset familiarisation; guided immersive tasks; closing check and reassurance.
Scenario categories	Virtual orientation/exploration; attention and visual search; memory/reminiscence; iADL-like situations; calming nature or familiar scenes.
Individual adaptation	Pace, task length, prompts, stimulus complexity, and verbal guidance adjusted to fatigue, attention, comprehension, and emotional response.
Safety rules	Pause or terminate for fatigue, nausea, anxiety, marked disorientation, refusal, or any adverse response.
Replicability principle	Stable three-part structure combined with person-centred adaptation for comparable care settings.

Note: This protocol description is intended to support reproducibility while acknowledging that person-centred adaptation is necessary when VR is used with people with dementia in routine care.

function, which is fully consistent with the logic of pilot single-case methodology.

VR Intervention Protocol

The VR intervention was delivered as a structured supplementary programme within the participant's routine social-care environment. Sessions were administered three times per week during the intervention phases and lasted approximately 50 minutes, including orientation, task engagement, pauses when needed, and closing debriefing. The intervention was delivered by a trained member of the research/intervention team in a quiet and familiar room of the facility. The participant was seated during headset use unless a scenario required only minimal upper-limb movement, and a staff member remained present throughout the session to provide reassurance, repeat instructions, monitor fatigue, and terminate the session if discomfort or disorientation occurred. The headset was fitted individually, visual comfort was checked before the main task, and the device was cleaned according to facility hygiene procedures after each session.

The hardware platform was a commercially available Meta Quest head-mounted display. The intervention did not depend on a single narrow cognitive exercise; instead, it combined selected Meta Quest-compatible immersive modules and scenarios that could be adapted to the participant's current tolerance and cognitive state. The content focused on orientation in virtual environments, visual attention and search, simple memory and reminiscence prompts, instrumental-activity-like situations, and calming nature or familiar-environment scenes. The therapeutic logic was to combine cognitive stimulation with meaningful, emotionally acceptable, and ecologically interpretable activities, while avoiding excessive sensory load. The same general session structure was maintained across the programme, but the difficulty, pace, duration of individual tasks, and level of verbal guidance were adapted to the participant's fatigue, attention, comprehension, and emotional response.

Data Processing and Collection Methods

A preliminary single-case ABAB experimental design was employed to examine phase-related changes in cognitive functioning and to verify the feasibility of the proposed intervention procedures prior to the main study. The study followed an ABAB structure in which phase A represented periods without the experimental VR intervention and phase B represented periods during which the VR intervention was administered. Data collection was carried out over a 12-month period, from January to December 2025. The phases were organized as follows: A1 (January-February), B1 (March-June), A2 (July-August), and B2 (September-December). This structure made it possible to observe the participant's performance before the intervention, during the first intervention period, during temporary withdrawal, and after reintroduction of the intervention under naturalistic care conditions. During the non-intervention phases, the participant did not receive the experimental VR therapy and continued to receive only the standard care routinely provided by the social services facility. In accordance with the ABAB design, the intervention was temporarily suspended during July and August 2025, while regular follow-up assessment was maintained throughout the entire monitoring period. To monitor cognitive development, repeated assessment was performed using the Addenbrooke's Cognitive Examination (ACE). Baseline assessment was conducted during the initial non-intervention period, followed by regular monthly follow-up measurements. For the purposes of this preliminary analysis, two subdomains were selected as primary outcome

indicators: attention/orientation and memory. These domains are directly implicated in the cognitive profile of Alzheimer's disease and were considered suitable for monitoring short-term fluctuations within the ABAB phase structure. The remaining ACE subdomains are reserved for reporting in the main study, where a broader outcome analysis is planned.

Design limitations

The initial A1 baseline included only two monthly data points. Although both A1 measurements were identical in the monitored ACE subdomains, this baseline length is below commonly recommended standards for stable baseline inference in single-case experimental designs. The short baseline substantially constrains internal validity because it prevents a robust assessment of pre-intervention trend, variability, and natural fluctuation. Consequently, the present study cannot determine with confidence whether the subsequent phase-related changes were attributable to the VR intervention itself or partly to practice effects, measurement error, contextual factors, regression toward the mean, or spontaneous variability in the participant's performance. A longer A1 phase was not feasible in this preliminary implementation because the study had to be embedded within the pre-agreed 12-month schedule of the social-care facility and the planned alternation of intervention and withdrawal periods. Extending A1 would have delayed the start of the supplementary programme for the selected participant and would have shortened the later intervention or withdrawal phases, thereby reducing the practical value of the feasibility test. For this reason, the baseline is treated as a descriptive feasibility baseline rather than as a statistically or experimentally robust stable-baseline estimate. The analytical strategy therefore deliberately avoids causal language and interprets the observed pattern as exploratory and clinically promising only. This limitation directly informs the planned main study. The next phase of research should include a longer pre-intervention baseline, preferably with at least five repeated measurements before intervention onset or with baseline continuation until predefined stability criteria are met. These criteria should be specified prospectively and may include absence of a systematic improving trend, limited variability across consecutive measurements, and a pre-established decision rule for phase transition. Such a procedure would strengthen internal validity, reduce the risk of overestimating treatment-related change, and improve the interpretability of PND, RCI, and visual analysis.

Data processing was based primarily on descriptive and visual analysis, which is methodologically appropriate for a preliminary single-case design with one participant. Inferential statistical procedures were not applied, as the sample size and exploratory nature of the study did not allow for meaningful statistical generalization. Raw scores obtained in repeated measurements were organized chronologically and interpreted with respect to phase-related changes in performance. The main analytic emphasis was placed on changes in score level, direction of trend, overlap between phases, and the contrast between intervention and non-intervention phases. Particular caution

Tab. 2. Monthly scores on two subdomains of the Addenbrooke's Cognitive Examination (ACE)

Month	Phase	Attention/orientation (max. 18)	Memory (max. 26)	Combined (A/O + Memory)
January	A1 non-intervention	11	16	27
February	A1 non-intervention	11	16	27
March	B1 intervention	10	16	26
April	B1 intervention	11	17	28
May	B1 intervention	13	18	31
June	B1 intervention	13	17	30
July	A2 non-intervention	12	17	29
August	A2 non-intervention	11	15	26
September	B2 intervention	11	15	26
October	B2 intervention	12	16	28
November	B2 intervention	12	16	28
December	B2 intervention	13	18	31

Note: attention/orientation (maximum 18 points) and memory (maximum 26 points) were recorded across a single-case ABAB design in one participant with Alzheimer's disease (N = 1), January–December 2025. Phase A1 (non-intervention): January–February; Phase B1 (VR intervention): March–June; Phase A2 (non-intervention): July–August; Phase B2 (VR intervention): September–December. Scores are raw values from individual monthly administrations; no imputation was performed. The combined score reflects only the two reported subdomains. RCI calculations reported in the Results use the full ACE total score at the relevant intervention endpoints. Because A1 included only two monthly measurements, the initial baseline should be understood as a descriptive feasibility baseline rather than a robust stable-baseline estimate.

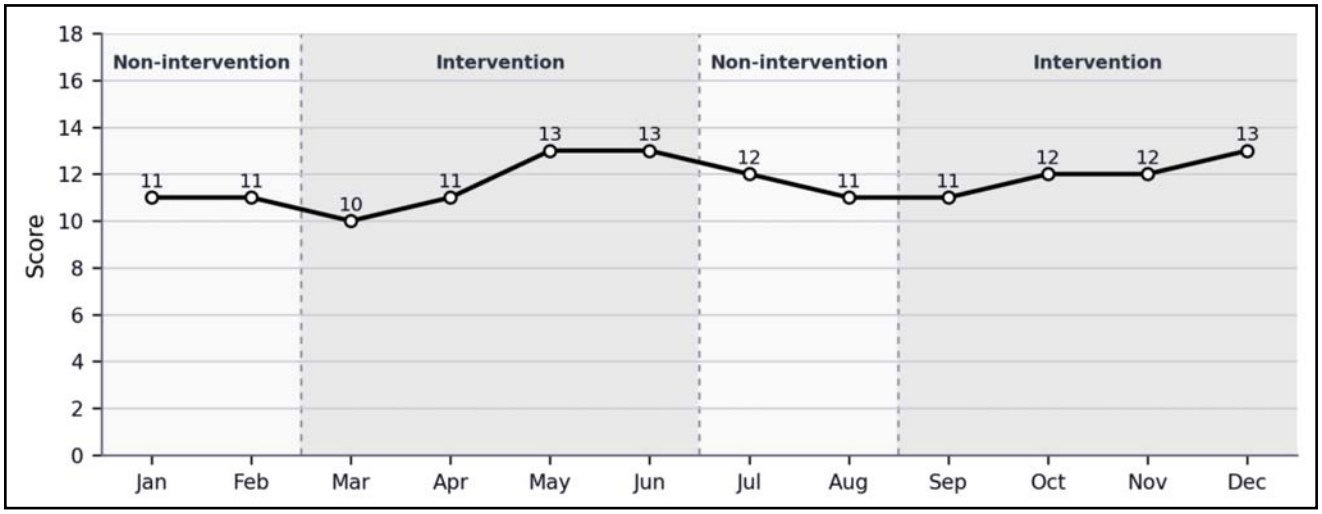

Fig. 1. Monthly scores on the attention/orientation subdomain of the Addenbrooke's Cognitive Examination

Note: ACE attention/orientation subdomain (maximum 18 points) across a 12-month single-case ABAB design (N = 1; Alzheimer's disease; social services facility, 2025). Shaded regions indicate intervention phases (B1: March–June; B2: September–December), in which VR-based sessions were delivered three times per week for approximately 50 minutes per session. Unshaded regions indicate non-intervention phases (A1: January–February; A2: July–August). Vertical dashed lines mark phase transitions. The dashed horizontal reference line indicates the initial A1 reference score (11 points, January). PND (B1) = 50%; PND (B2) = 25%. The short A1 phase limits baseline stability inference.

was applied when interpreting the initial baseline because A1 included only two monthly measurements.

Given the presence of measurement error and potential practice effects in repeated cognitive testing, observed changes were interpreted cautiously. Changes exceeding approximately 4-5 points on the ACE subdomains were considered potentially clinically meaningful, whereas smaller fluctuations were treated as possibly attributable to measurement variability. The purpose of the preliminary analysis was therefore not to establish definitive effectiveness, but to determine whether the intervention showed a promising developmental pattern, whether the selected assessment tools were feasible and sufficiently sensitive, and whether any procedural ambiguities needed to be addressed before implementation of the main study. To improve interpretation of the results, two quantitative indices were used to contextualize phase-related change without implying statistical generalization:

Percentage of Non-overlapping Data (PND) was calculated across intervention phases to describe the proportion of intervention-phase scores that exceeded the relevant non-intervention comparison values.

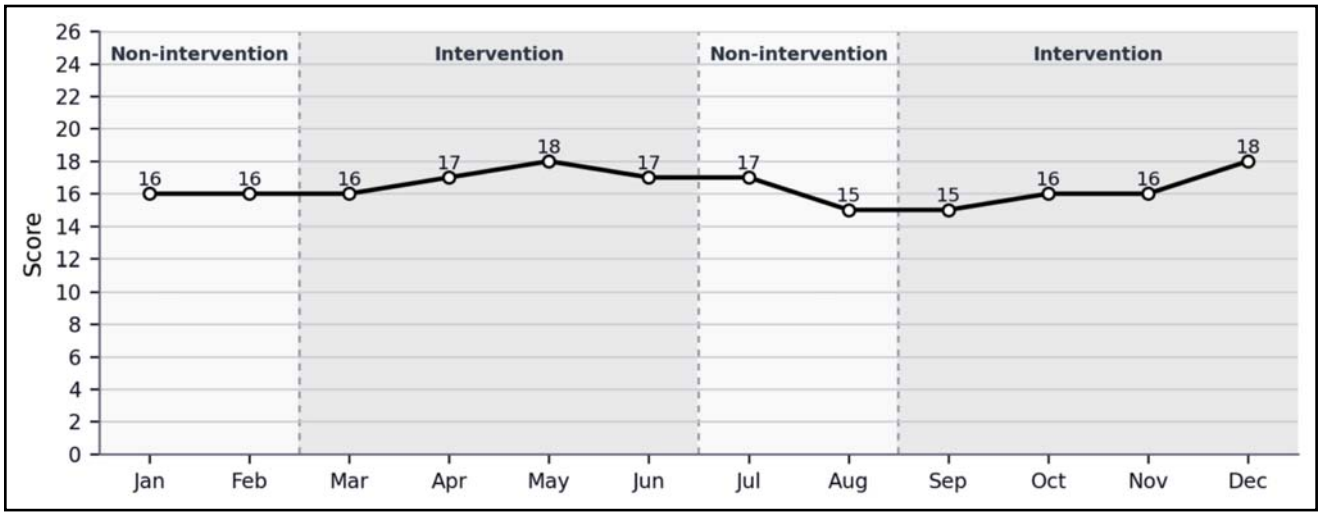

Fig. 2. Monthly scores on the memory subdomain of the Addenbrooke's Cognitive Examination

Note: ACE memory subdomain (maximum 26 points) across a 12-month single-case ABAB design (N = 1; Alzheimer's disease; social services facility, 2025). Shaded regions indicate intervention phases (B1: March–June; B2: September–December); unshaded regions indicate non-intervention phases (A1: January–February; A2: July–August). Vertical dashed lines mark phase transitions. The dashed horizontal reference line indicates the initial A1 reference score (16 points, January). PND (B1) = 75%; PND (B2) = 25%. The memory subdomain showed the strongest phase-specific non-overlap in B1, but the short A1 phase limits baseline stability inference.

The Reliable Change Index (RCI) was used as an approximate indicator of whether observed change exceeded the level expected from measurement error, using published ACE-III reliability parameters (Hsieh *et al.* 2013).

Table 2 and Figures 1 and 2 present the monthly results for the two selected subdomains of the Addenbrooke's Cognitive Examination, namely attention/orientation and memory, as well as their combined two-subdomain score across the individual phases of the ABAB design. As only these two subdomains are reported in this preliminary analysis, the combined score reflects the sum of attention/orientation and memory only and is not equivalent to the full five-domain ACE total score. In the first non-intervention phase (January-February), both available A1 measurements were identical: attention/orientation remained at 11 points and memory at 16 points. These identical values suggest no visible change during the observed A1 period; however, because A1 consisted of only two data points, it cannot be interpreted as methodologically sufficient evidence of stable baseline performance. Percentage of Non-overlapping Data (PND) was 50% for attention/orientation and 75% for memory during the first intervention phase (B1, March-June), and 25% for both domains during the second intervention phase (B2, September-December). Using published ACE-III test-retest parameters (Hsieh *et al.* 2013), RCI was calculated for the full ACE total score at relevant intervention phase endpoints. The RCI for the change from 64 to 75 points across B1 was 1.56, and the RCI for the change from 68 to 75 points across B2 was 0.99. Neither value exceeded the conventional threshold of 1.96; therefore, the observed changes should be interpreted as clinically promising but not statistically reliable at the individual-case level. After the intervention was introduced in March, attention/orientation increased from 10 points in March to 13 points in May and remained at 13 points in June, while memory improved from 16 points in March to 18 points in May and remained at 17 points in June. During the withdrawal phase (July-August), both monitored domains declined. After reintroduction of the intervention in September, performance again showed a positive trend, reaching 13 points in attention/orientation and 18 points in memory in December. Overall, the descriptive pattern is compatible with favourable phase-related change during the intervention periods, but the short baseline and single-case character of the study preclude causal inference.

Discussion

The present preliminary single-case study explored the feasibility of a VR-based intervention in a person with dementia due to Alzheimer's disease and examined whether repeated monthly assessment could capture phase-related changes across a 12month ABAB withdrawal design. The findings should be interpreted primarily as methodological and implementation-oriented evidence. In comparison with previous VR studies that have mainly evaluated short-term feasibility, behavioural and psychological symptoms, reminiscence, exergaming, or instrumental-activity-based training in group designs or brief pre-post formats, the present study contributes a long-duration, repeated-measure single-case model implemented in a routine social-care facility (Appel *et al.* 2021; Appel *et al.* 2024; Saredakis *et al.* 2020; Shin *et al.* 2023; Clay *et al.* 2024; Prinz *et al.* 2024). Its uniqueness lies in the combination of a 12month ABAB structure, monthly ACE monitoring, visual interpretation, PND and RCI indices, and explicit feasibility framing. The study therefore does not attempt to demonstrate generalizable efficacy, but rather to test whether such a design and intervention format can be implemented and refined for a future main study. The observed pattern, characterized by improvement during intervention phases and decline during the withdrawal phase, is consistent with a possible intervention-related response. Nevertheless, the strength of this interpretation is limited. The strongest phase-specific non-overlap was observed for memory during B1, whereas PND values in B2 were only 25 % for both monitored domains, indicating that an effect cannot be demonstrated by this index in the second intervention phase. In addition, neither RCI value exceeded the conventional threshold for statistically reliable individual change. These findings suggest that the intervention may have been associated with clinically promising fluctuations, but they do not support a definitive claim of statistically reliable improvement at the individual-case level. Alternative explanations such as individual variability, repeated testing, measurement error, novelty effects, contextual changes in the facility, fatigue, or regression toward the mean cannot be excluded. The most important design limitation is the short initial A1 baseline. Although the two A1 measurements were identical, two data points are insufficient to establish a stable baseline or to rule out a pre-existing trend. This limitation weakens internal validity and restricts the ability to attribute phase-related change to the VR intervention. For this reason, all causal statements were avoided and the findings were framed as preliminary feasibility evidence. The experience is methodologically informative for the planned main study: future protocols should include a longer baseline, preferably at least five repeated measurements before intervention onset or continuation until predefined stability criteria are met. Stability criteria should be defined prospectively and should include acceptable variability, absence of systematic improvement before intervention, and clear phase-transition rules. A stronger baseline would improve the interpretation of visual analysis, PND, RCI, and clinically meaningful change. From an implementation perspective, the study supports the practical feasibility of delivering a structured VR programme through

a commercially available Meta Quest head-mounted display in a social-care setting. The detailed protocol description added to the Methods section is important because reproducibility in dementia care depends not only on hardware, but also on session structure, adaptation rules, staff supervision, and clear safety procedures. The participant's tolerance of the headset and the absence of reported adverse response suggest that VR can be integrated into routine care when it is delivered in a seated position, with simplified instructions, continuous monitoring, and the possibility of immediate discontinuation. Future studies should combine cognitive outcomes with measures of usability, tolerability, emotional response, everyday functioning, staff workload, organizational readiness, and sustainability. Such an approach would make it possible to evaluate not only whether VR produces measurable cognitive change, but also whether it can realistically become part of comprehensive non-pharmacological dementia care (Wong *et al.* 2024; Wong *et al.* 2025; Sadowski *et al.* 2026).

Conclusion

This preliminary single-case study provides initial evidence that a structured VR-based intervention is acceptable and practically feasible in a social-care setting and may be associated with favourable phase-related changes in selected cognitive functions in a person with dementia due to Alzheimer's disease. The study's main contribution is methodological and implementation-oriented: it demonstrates the practical use of a 12-month ABAB withdrawal structure with monthly ACE monitoring, visual interpretation, PND, and RCI in routine care. However, the short A1 baseline, the single-case design, and the absence of statistically reliable RCI change do not allow causal conclusions or generalization. The findings should therefore be understood as clinically promising feasibility evidence rather than proof of efficacy. The planned main study should use a longer and prospectively stabilized baseline, clearer phase-transition criteria, a fully manualized VR intervention protocol, broader outcome indicators, and implementation measures addressing usability, tolerability, staff demands, emotional response, everyday functioning, and sustainability in care environments.

Funding

This publication was created with the support of the ITI – DIGITECH project, Reg. No.: CZ.02.01.01/00/23_021/0010653, financed by OP JAK. (https://opjak.cz/en/)

Institutional review board statement

The study was approved by the Ethical Committee Faculty of Health Studies, Jan Evangelista Purkyně University in Ústí nad Labem, Czech Republic.

Conflicts of interest

The authors declare no conflict of interest.

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