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Reporting Summary

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Statistics

For all statistical analyses, confirm that the following items are present in the figure legend, table legend, main text, or Methods section.

n/a	Confirmed	
☐	☒	The exact sample size (*n*) for each experimental group/condition, given as a discrete number and unit of measurement
☐	☒	A statement on whether measurements were taken from distinct samples or whether the same sample was measured repeatedly
☐	☒	The statistical test(s) used AND whether they are one- or two-sided *Only common tests should be described solely by name; describe more complex techniques in the Methods section.*
☐	☒	A description of all covariates tested
☐	☒	A description of any assumptions or corrections, such as tests of normality and adjustment for multiple comparisons
☐	☒	A full description of the statistical parameters including central tendency (e.g. means) or other basic estimates (e.g. regression coefficient) AND variation (e.g. standard deviation) or associated estimates of uncertainty (e.g. confidence intervals)
☐	☒	For null hypothesis testing, the test statistic (e.g. *F*, *t*, *r*) with confidence intervals, effect sizes, degrees of freedom and *P* value noted *Give P values as exact values whenever suitable.*
☒	☐	For Bayesian analysis, information on the choice of priors and Markov chain Monte Carlo settings
☒	☐	For hierarchical and complex designs, identification of the appropriate level for tests and full reporting of outcomes
☐	☒	Estimates of effect sizes (e.g. Cohen's *d*, Pearson's *r*), indicating how they were calculated

Our web collection on statistics for biologists contains articles on many of the points above.

Software and code

Policy information about availability of computer code

Data collection	Primary and secondary outcome surveys for parents were administered on paper in person; surveys for adult children were administered online via the Qualtrics platform. For secondary outcomes, audio and videotaped data were also collected. No custom software was used for data collection.
Data analysis	All statistical analyses were conducted in IBM SPSS, Version 30; figures were created in R, Version 4.6.0.

For manuscripts utilizing custom algorithms or software that are central to the research but not yet described in published literature, software must be made available to editors and reviewers. We strongly encourage code deposition in a community repository (e.g. GitHub). See the Nature Portfolio guidelines for submitting code & software for further information.

Data

Policy information about availability of data

All manuscripts must include a data availability statement. This statement should provide the following information, where applicable:

- Accession codes, unique identifiers, or web links for publicly available datasets
- A description of any restrictions on data availability
- For clinical datasets or third party data, please ensure that the statement adheres to our policy

Deidentified data, analysis code, and supporting documents will be made available via the NACDA-Open Aging Repository (NACDA-OAR) to researchers affiliated

with institutions holding a Federal Wide Assurance (FWA). Access requires registration and agreement to NACDA's conditions of use. For replication purposes, materials may also be requested directly from the corresponding author (Prof. Tamara Afifi, tafifi@ucsb.edu).

Research involving human participants, their data, or biological material

Policy information about studies with human participants or human data. See also policy information about sex, gender (identity/presentation), and sexual orientation and race, ethnicity and racism.

Reporting on sex and gender	Sex was assessed by self-report for both parents and adult children (parents: 69% female; adult children: 60% female) and was included as a covariate in all primary-outcome and secondary-outcome models. Gender identity (as distinct from sex) was not separately assessed. Findings were not restricted to one sex; sex differences were not a focus of hypothesis testing and are not reported by group.
Reporting on race, ethnicity, or other socially relevant groupings	Race/ethnicity was self-reported at intake (parents: 96% White; adult children: 95% White). Ethnicity was similar across intervention groups and aligns with broader demographic characteristics of individuals residing in senior living communities within the U.S. Race/ethnicity was not used as a study covariate or moderator.
Population characteristics	See below (Behavioural & social sciences study design section) for full description of the research sample. Briefly: 186 parent–adult child dyads (372 individuals). Parents: ages 60–99 (M=85.8, SD=7.5), 69% female, 64% widowed, 96% White, MMSE-2 range 13–27 (M=23.0, SD=3.72), 46% with MCI and 54% with mild-to-moderate ADRD. Adult children (or other caregiving relative, 5%): M age=56.4 (SD=10.2), 60% female, 95% White, residing in 29 U.S. states and 8 countries.
Recruitment	Parents were recruited on-site from 23 senior living communities (SLCs) in two U.S. regions (Boston, MA and Santa Barbara, CA and surrounding areas), including 5 low-income sites (one primarily Spanish-speaking), via screening interviews and the MMSE-2 conducted by SLC staff/research team. Eligible parents then nominated an adult child (or, if unavailable [5% of cases], another caregiving relative) who was screened by phone. Because participation required an available, willing family member living ≥45 minutes away, the sample may be biased toward dyads with stronger existing family engagement; this self-selection could inflate estimates of the intervention's relational benefits relative to families with more limited contact. The predominantly White, highly educated sample also limits generalizability, as noted in the manuscript's Limitations.
Ethics oversight	This study was approved by the Human Subjects Review Committee (Institutional Review Board) of the University of California, Santa Barbara. The study was registered on Clinicaltrials.gov (NCT05150990). Informed consent was obtained from all participants and, when relevant, by a legally authorized representative for older adults with mild to moderate dementia. Independent safety oversight was provided by an Independent Safety Monitor (ISM) who was not otherwise involved in the conduct of the study.

Note that full information on the approval of the study protocol must also be provided in the manuscript.

Field-specific reporting

Please select the one below that is the best fit for your research. If you are not sure, read the appropriate sections before making your selection.

☐ Life sciences ☒ Behavioural & social sciences ☐ Ecological, evolutionary & environmental sciences

For a reference copy of the document with all sections, see nature.com/documents/nr-reporting-summary-flat.pdf

Behavioural & social sciences study design

All studies must disclose on these points even when the disclosure is negative.

Study description	A stratified, unblinded, parallel-group, multisite randomized controlled trial comparing a 4-week socially enriched virtual reality (VR) intervention ("Thrive") against an active video conferencing (VC) control group.
Research sample	The sample comprised 186 dyads (372 individuals): a parent aged ≥50 with mild cognitive impairment (MCI; MMSE-2 25–27) or mild-to-moderate Alzheimer's disease/related dementias (ADRD; MMSE-2 13–24) residing in a senior living community, paired with an adult child (or other caregiving relative, 5% of cases) aged ≥18 living ≥45 minutes away. Parents: M age=85.8 (SD=7.5), 69% female, 64% widowed, 96% White, 62.3% with a bachelor's degree or higher. Adult children: M age=56.4 (SD=10.2), 60% female, 95% White, 83.8% with a bachelor's degree or higher. The sample is not nationally representative; it was drawn from 23 SLCs in two U.S. regions, oversampling low-income and Spanish-speaking sites to increase socioeconomic/ethnic diversity, though the realized sample remained predominantly White and highly educated.
Sampling strategy	Convenience/purposive sampling of eligible dyads across 23 participating SLCs. Sample size was determined by an a priori power analysis (simulation methods for multilevel regression), using effect sizes from the authors' Phase 1 feasibility study. A target of 192 dyads (96/group) was calculated to detect a minimal effect size (Cohen's d=0.20) with 85% power and two-sided α=0.05, assuming 15% attrition. Recruitment was closed at 186 dyads (short of the 192 target) due to COVID-19-related access disruptions at SLCs and the funding window; this was judged acceptable because retention (89%) met the a priori target of ≥164 completed dyads.
Data collection	Parents completed paper surveys in person with a research team member; adult children completed surveys online. Weekly VR/VC sessions were audio-recorded (and, for parents, video-recorded) with consent (95% of parents, 90% of adult children consented), yielding 372 hours of audio/video data later coded for engagement. A researcher was present to operate equipment/provide technical support during sessions (for both conditions). Older adults completed outcome surveys on paper and pencil with assistance

	from a research assistant as needed (surveys were administered verbally for participants with mild to moderate dementia). Adult children completed their surveys online, independently. Research staff and participants were not blinded to intervention condition, given the nature of the technologies being compared.
Timing	Recruitment and data collection ran from September 2021 to March 2024 (recruitment specifically September 2021–November 2023). The 4-week intervention consisted of one weekly session; primary outcomes were assessed at baseline, ~1 week post-intervention, and 1- and 3-months post-intervention.
Data exclusions	No exclusions of enrolled participants' data were made; all randomized participants were retained under an intention-to-treat approach, including those who withdrew after baseline.
Non-participation	Of 1,163 individuals approached, 791 were excluded before randomization (375 not interested, 252 ineligible, 164 other reasons). Of 186 enrolled dyads (372 individuals), 166 (89%) completed the intervention. Twenty dyads and 12 individuals withdrew or were lost to follow-up: 10 dyads withdrew pre-intervention (mainly time/health reasons), 10 withdrew during the intervention (mainly health; also family tension [n=2], physical discomfort with VR [n=1], parental death [n=1]); 8 individuals withdrew post-intervention (mainly survey burden or parental illness/death) and 4 were lost to follow-up. Post-intervention survey retention was 89% for parents and 88% for adult children; 3-month retention was 88% and 87%, respectively. Attrition did not differ by intervention group.
Randomization	Dyads were randomized 1:1 to VR or VC using a computer-generated allocation table (randomizeR package in R), stratified by parents' cognitive status (MCI vs. ADRD) and geographic region (Boston vs. California) to balance these covariates across groups. Because the intervention modality is directly experienced by participants and staff, allocation could not be concealed/blinded after assignment; participants and research staff were unblinded to condition.

Reporting for specific materials, systems and methods

We require information from authors about some types of materials, experimental systems and methods used in many studies. Here, indicate whether each material, system or method listed is relevant to your study. If you are not sure if a list item applies to your research, read the appropriate section before selecting a response.

Materials & experimental systems

n/a	Involved in the study
☒	☐ Antibodies
☒	☐ Eukaryotic cell lines
☒	☐ Palaeontology and archaeology
☒	☐ Animals and other organisms
☐	☒ Clinical data
☒	☐ Dual use research of concern
☒	☐ Plants

Methods

n/a	Involved in the study
☒	☐ ChIP-seq
☒	☐ Flow cytometry
☒	☐ MRI-based neuroimaging

Clinical data

Policy information about clinical studies

All manuscripts should comply with the ICMJE guidelines for publication of clinical research and a completed CONSORT checklist must be included with all submissions.

Clinical trial registration	ClinicalTrials.gov NCT05150990
Study protocol	The study protocol is available at ClinicalTrials.gov NCT05150990
Data collection	Data were collected in person at 23 senior living communities in two U.S. regions (Boston, MA and Santa Barbara, CA and surrounding areas) and remotely (online surveys for adult children; VR/VC sessions conducted with the parent at the SLC and the adult child from their own home). Recruitment and data collection took place from September 2021 to March 2024 (enrollment/recruitment window: September 2021–November 2023).
Outcomes	Primary outcomes (pre-specified in the trial design) were psychological well-being, psychological distress, social connection/network support, loneliness, and relationship quality (for parents); and psychological well-being, psychological distress, perceived stress, caregiver guilt, social connection, and relationship quality (for adult children) — assessed via validated self-report scales (e.g., QoL-AD, Brief/Comprehensive Inventory of Thriving, PANAS, GDS-SF, MHI-5, LSNS-6, CESD-R-10, Perceived Stress Scale, Caregiver Guilt Scale, Unidimensional Relationship Closeness Scale) at baseline, 1-week post-intervention (primary endpoint), and 1- and 3-month follow-up. Secondary outcomes (session-level engagement: emotional, conversational, reminiscence, and kinesic engagement) were pre-specified and assessed via post-session self-report and observational/automated (OpenPose) coding of session recordings, averaged across the four weekly sessions.

Plants

Seed stocks

Report on the source of all seed stocks or other plant material used. If applicable, state the seed stock centre and catalogue number. If plant specimens were collected from the field, describe the collection location, date and sampling procedures.

Novel plant genotypes

Describe the methods by which all novel plant genotypes were produced. This includes those generated by transgenic approaches, gene editing, chemical/radiation-based mutagenesis and hybridization. For transgenic lines, describe the transformation method, the number of independent lines analyzed and the generation upon which experiments were performed. For gene-edited lines, describe the editor used, the endogenous sequence targeted for editing, the targeting guide RNA sequence (if applicable) and how the editor was applied.

Authentication

Describe any authentication procedures for each seed stock used or novel genotype generated. Describe any experiments used to assess the effect of a mutation and, where applicable, how potential secondary effects (e.g. second site T-DNA insertions, mosiacism, off-target gene editing) were examined.