

Enhancing Memory Through Targeted Training Techniques

September 8, 2025 in **Medicine** Reading Time: 4 mins read

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As global populations continue to age, dementia has emerged as one of the most pressing healthcare challenges of the 21st century, particularly across Europe where nearly one in ten individuals over the age of 70 currently suffer from this debilitating condition. Projections indicate that by the year 2050, these numbers could potentially triple, a consequence of increased life expectancy and demographic shifts. Dementia, an umbrella term for neurodegenerative disorders characterized by cognitive decline, progressively strips individuals of their memories and autonomy, leading to severe impairments not only cognitively but also physically. Ultimately, those affected require intensive and comprehensive care that places significant demands both on healthcare systems and families.

Amidst the search for therapeutics that can alter the trajectory of diseases such as Alzheimer's—the most prevalent form of dementia—researchers have encountered a formidable obstacle: while the first pharmacological agents capable of modestly slowing early-stage disease progression have appeared, their availability remains limited. For example, these medications have yet to receive authorization in countries like Switzerland and cater only to a narrow cohort of patients. Given these limitations, non-pharmacological interventions aimed at enhancing brain plasticity and physical health without adverse effects are gaining substantial interest. Among these, “exergames”—a portmanteau of exercise and gaming—have attracted attention as a promising and low-risk complement or alternative to medication regimens.

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Exergames synthesize physical movement with cognitive challenges by engaging users in interactive, game-based experiences that stimulate both mind and body simultaneously. Prior research spearheaded by ETH Zurich revealed that such game-based training could enhance cognitive function, clarify mental acuity, improve physical fitness, and boost overall quality of life even in individuals suffering from advanced dementia. Building on these foundational insights, two recent groundbreaking studies from ETH Zurich extend these findings by demonstrating that exergaming yields significant cognitive and neurological benefits in older adults diagnosed with mild cognitive impairment (MCI), a prodromal stage often preceding full-blown dementia.



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The latest research involved approximately 40 study participants averaging 73 years of age, all exhibiting MCI at baseline. This cohort engaged in individually tailored exergame training at home, utilizing a system that combined a visual display running specialized cognitive exercises with a floor-mounted pad outfitted with four distinct stepping fields. Over a period of 12 weeks, participants committed to roughly 25 minutes of training sessions five times per week. The tasks required precise foot movements that corresponded with cognitive decision-making processes, such as memorizing sequences, spatial orientation, and pattern recognition. A typical exercise involved memorizing a shopping list followed by onboard prompts requiring the participant to step right or left to confirm whether an item displayed on-screen was included in the memorized list.

This innovative approach targets neuropsychological domains specifically vulnerable to decline in dementia, including attention, working memory, and visuospatial capabilities. Moreover, the inclusion of controlled breathing exercises immediately following the physical-cognitive tasks was designed to modulate autonomic nervous system function via stimulation of the vagus nerve. Such stimulation is hypothesized to activate cerebral regions integral to cognitive processing, thereby potentially amplifying the training's effectiveness through enhanced physiological neuroregulation.

Results from the initial study revealed robust improvements in cognitive performance and memory retention among participants undergoing the exergame-based regimen. These gains were not merely statistically significant but manifested tangibly within everyday life activities. Participants reported heightened mental clarity, increased feelings of physical fitness, and improved self-

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A complementary, structural brain changes measurable via advanced neuroimaging techniques. Utilizing high-resolution magnetic resonance imaging (MRI), researchers observed volumetric increases in critical brain regions intimately tied to memory and cognitive function, specifically the hippocampus and thalamus. These areas are frequently compromised in early dementia and serve pivotal roles in information processing and retrieval. Additional neural substrates exhibiting positive trends included the anterior cingulate cortex and prefrontal cortex, both crucial for executive functions such as decision making and attention regulation. In stark contrast, participants in the control cohort demonstrated continued atrophy within these areas over the study period.

The observation of increased gray matter volume within the hippocampus is particularly significant, as hippocampal shrinkage is a hallmark biomarker associated with neurodegenerative decline. This finding highlights the remarkable plasticity of the human brain, illustrating that even in individuals manifesting early dementia symptoms, it is possible to promote neurogenesis or at least halt neurodegeneration with appropriately designed cognitive and physical stimuli. The correlation between the brain volume increases and improved cognitive outcomes provides a compelling argument for a causal, disease-modifying mechanism underlying the observed benefits of exergame training.

Professor Eling D. de Bruin, who led the research at ETH Zurich and the Eastern Switzerland University of Applied Sciences, emphasized both the promise and the need for further investigation. While the current evidence provides encouraging preliminary confirmation that exergame interventions can bolster brain health and cognitive performance during mild neurocognitive impairment, longer-term studies are essential to ascertain whether such training can delay or potentially prevent the onset of full-blown dementia. The research team is actively planning extended longitudinal trials to evaluate sustained effects over periods greater than three months.

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These studies collectively open a new frontier in dementia care, one that harnesses accessible, technology-driven approaches to engage the brain's intrinsic capacity to reorganize and heal. By integrating physical activity with targeted cognitive challenges, exergames represent a scalable, side-effect-free method for combating cognitive decline. If larger trials corroborate these findings, it could transform the therapeutic landscape for millions worldwide—a prospect that holds profound implications not only for patients but also for healthcare systems striving to manage the growing dementia burden.

The exergame training described breaks away from traditional passive interventions by capitalizing on active engagement and motor-cognitive coupling. This dual demand on neural circuits promotes more widespread and integrated brain activation than conventional cognitive training alone. Importantly, the intervention is designed for home use, increasing accessibility for elderly individuals who may be constrained by mobility or geographic barriers. The participatory and gamified nature of the exercises also appears to enhance adherence, a chronic challenge in therapeutic regimens for cognitive disorders.

In sum, these pioneering investigations articulate a compelling narrative: that through carefully tailored, serious gaming strategies combining physical movement and cognitive challenge, it is possible to induce structural and functional brain improvements in the early stages of dementia. They underscore the value of multidimensional intervention paradigms that transcend pharmacology, reinforcing hope for effective, noninvasive means to safeguard mental faculties in aging populations.

Subject of Research: Effects of individualized exergame-based training on brain structure and cognitive function in individuals with mild neurocognitive disorders.

Article Title: Structural Brain Improvements Following Individually Tailored Serious Exergame-based Training in Mild Neurocognitive Disorders: Exploratory Randomized Controlled Trial

News Publication Date: 8-Sep-2025

Web References: [DOI link](#)

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Keywords: Dementia, Mild Cognitive Impairment, Exergames, Brain Plasticity, Hippocampus, Neurodegeneration, Cognitive Training, Physical Exercise, Alzheimer's Disease, Neuroimaging, Autonomic Nervous System, Vagus Nerve Stimulation