Brain Training and Dementia—Media FAQ

The Study Results

Q: What are the new scientific results?
A: Researchers have evaluated data from a ten-year study of cognitive training and shown that a specific type of brain training can reduce the risk of dementia. This is the first time that anything—brain-training program, physical exercise, diet/nutrition, or drug—has been shown to have this effect.

Q: What did the study show?
A: The group of people who used one specific cognitive training program, called "speed training" in the study, showed a statistically significant 33% reduction in the incidence of dementia. The effect was larger for people who did more of the training, with the group of people who did additional "booster" training showing a 48% reduction in the incidence of dementia. The other cognitive training programs showed no significant effect.

Q: How was the study conducted?
A: These new results come from the Advanced Cognitive Training for Independent and Vital Elderly (ACTIVE) study, a large multi-site randomized controlled trial organized and funded by the National Institutes of Health. ACTIVE enrolled 2,832 community-dwelling and generally healthy participants, with an average age of 74. They were randomly assigned into one of three cognitive training groups (speed, memory, or reasoning training), or to a control group. A comprehensive set of cognitive assessments was done before training, after training, and 1, 2, 5, and 10 years after training. Researchers classified which participants went on to dementia using previously established criteria based upon interview and performance data characterizing cognitive and functional status.

Q: What cognitive training programs were used in ACTIVE?
A: ACTIVE evaluated three different cognitive training programs:

- In *memory training*, participants were taught mnemonic strategies for remembering word lists and sequences of items, text material, and main ideas and details of stories. For example, participants were instructed how to organize word lists into meaningful categories and to form visual images and mental associations to recall words and texts.
- In *reasoning training,* participants focused on the ability to solve problems that follow a serial pattern, like identifying the pattern in a letter or number series or understanding the pattern in an everyday activity such as prescription drug dosing or travel schedules.
- In *speed training,* participants performed intensive, adaptive, computerized training that was designed to improve the speed and accuracy of visual information processing, while

expanding the visual area over which a person could pay attention and make rapid decisions.

Q: How much training did people in the ACTIVE study do?
A: Everyone assigned to a cognitive training program group was asked to do 10 hours of training. People trained in a group setting, twice per week for an hour at a time, over the course of five weeks. About half of the people in each cognitive training group were randomly assigned to do booster training, where they did an additional 4 hours of training at the end of the first year, and another 4 hours of training at the end of the third year, for a total of up to 18 hours for the booster group.

Q: Who were the scientists who organized the ACTIVE study?
A: ACTIVE was organized and funded by the National Institutes of Health (specifically, The National Institute on Aging and the National Institute for Nursing Research). Six principal investigators originally designed, executed, and analyzed the study:

- Dr. Karlene Ball (University of Alabama), Director of the UAB Edward R. Roybal Center for Research on Applied Gerontology
- Dr. George Rebok (Johns Hopkins University), Professor & Core Faculty, Center on Aging and Health
- Dr. Sherry Willis (Pennsylvania State University, University of Washington), Professor of Human Development
- Dr. Michael Marsiske (University of Florida), Associate Professor of Clinical & Health Psychology
- Dr. Fred Unverzagt (Indiana University), Professor of Clinical Psychology in Clinical Psychiatry
- Dr. John Morris (Hebrew Senior Life), Alfred A. and Gilda Slifka Chair in Social Gerontological Research

More than 40 other investigators contributed to the ACTIVE Study. The analyses of the recent results on reducing the risk of dementia were led by Dr. Jerri Edwards (University of South Florida), Director of the USF Cognitive Aging Lab and member of the ACTIVE study group.

Q: What other results has the ACTIVE study shown?
A: Previous results from the ACTIVE study have been published in dozens of peer-reviewed, academic journals including the *Journal of the American Medical Association* and the *Journal of the American Geriatrics Society* (among many others). Results have shown that all three types of cognitive training can improve cognitive function and protect against declines in instrumental activities of daily living—the skills required for a person to live independently in their own home. Speed training has uniquely been shown to improve everyday speed (activities like looking up a phone number, or reading a medication label), protect against declines in health-related quality of life and depressive symptoms, reduce predicted medical expenditures, improve locus of control, and reduce the incidence of at-fault car crashes.

The Science

Q: How can this unique type of brain training reduce the risk of dementia?
A: Neuroscientists now recognize that the brain is "plastic"—or capable of change—at any age. This ability to change—what scientists refer to as "brain plasticity"—is fundamental to how the brain perceives, thinks, remembers, and makes decisions. By building certains kinds of specific brain-training exercises based on the principles of brain plasticity, scientists can drive specific changes in the structure, function, and chemistry of the brain. Because dementia is a form of brain change itself, correctly designed types of brain training could halt or perhaps reverse the brain changes that lead to dementia.

Q: What changes in the brain as a result of plasticity-based brain training?
A: There are literally thousands of scientific papers in the field of brain plasticity documenting brain changes in animal models as a result of training programs. Researchers have now specifically studied plasticity-based training (very similar to the speed training in the ACTIVE Study) in animal models of aging, and have shown that plasticity-based training drives changes at the molecular, cellular, and systems level of the brain. At the molecular level, brain training has been shown to improve markers of neuromodulatory chemical synthesis and neural wiring integrity. At the cellular level, speed training has been shown to revivify the number of interneurons that coordinate coherent global brain activity. And at the systems level, this type of training improves the speed and accuracy of neural information processing.

Q: How can just 10 to 18 hours of brain training show such significant effects?
A: Plasticity-based training drives a very specific type of change in the brain, called "implicit learning" (also called perceptual learning, or non-declarative learning). This kind of learning is like learning to ride a bicycle—it drives significant brain change that can last a very long time. A child can learn to ride a bike in 10 hours—a learning activity that requires a tremendous amount of brain rewiring across the visual, motor, and balance systems. And once the child has learned how to ride a bike, they will retain that brain-based skill for decades. Plasticity-based training (such as the speed training used in the ACTIVE study) appears to work in the same way, driving a long-lasting, important brain change in the course of 10-18 hours of learning. Visual processing speed is a fundamental cognitive skill, which most of us employ nearly every second of every waking day. Normal aging (as well as diseases and disorders) typically results in a slowing of processing speed in each decade after our early 20's. Making a split second improvement in such a fundamental skill has been shown to have widespread effects.

The News

Q: How big a problem is dementia?
A: More than 5 million Americans and millions of other people around the world are living with dementia, with a new person developing dementia every 66 seconds. In 2016, the costs of dementia in the US will be over $236 billion. [source: Alzheimer's Association]

Q: Why are these results newsworthy?
A: This is the first result from a randomized controlled trial to show that any intervention—brain training, physical exercise, diet/nutrition, or drug—can cut the risk of dementia in healthy people.

Q: What about physical exercise, or the Mediterranean diet? I've heard those are good for the brain.
A: Physical exercise, particularly aerobic exercise, has been shown in randomized controlled trials to improve certain aspects of cognitive function, particularly executive function. However no randomized controlled trial has yet evaluated whether these effects reduce the risk of dementia. Diet/nutrition studies typically track what people report eating, and establish correlations between eating patterns and cognitive outcomes. Numerous large studies have now shown correlations between better diets (e.g., a Mediterranean diet) and better cognitive outcomes. However, without a randomized controlled trial, it's not possible to rigorously determine that eating the healthy diet leads to the better cognitive outcome, because it's possible that the kind of person who eats a healthy diet is already predisposed to have better brain health. So while the evidence for the positive effects of physical exercise and a healthy diet are good, neither have yet been shown in a "gold standard" randomized controlled trial to reduce the risk of dementia.

Q: What about medications, like cholinesterase inhibitors?
A: Cholinesterase inhibitors (like Aricept, Reminyl, or Exelon) have been shown to slow the rate of decline of people who already have Alzheimer's disease. However, in a number of large-scale randomized controlled trials, they have failed to protect healthy people from going on to develop Alzheimer's disease.

Q: What about other cognitively stimulating activities, like crossword puzzles?
A: Crossword puzzles (and sudoku, and the like) are a great way to spend an afternoon. But no randomized controlled trials have ever shown that doing crossword puzzles improves cognitive function, and no study has ever shown that starting crossword puzzles can reduce the risk of dementia. While studies have shown a correlation between doing cognitively stimulating activities (like crossword puzzles) and reduced risk of dementia, those studies have not been able to untangle cause and effect—perhaps people who aren't experiencing the earliest subtle signs of dementia are more likely to engage in crossword puzzles and other mentally stimulating activities.

The Cognitive Training Program

Q: Who invented speed training?
A: The "speed training" used in the ACTIVE Study was originally developed by Dr. Karlene Ball and Dr. Daniel Roenker. In their original studies of the basic science of visual attention, they developed a computerized assessment tool to measure the "Useful Field of View"—the visual area over which information can be extracted at a brief glance without eye or head movements.

In initial studies, they showed that this assessment was highly predictive of auto crashes in older adults. They also showed that the fundamental skill could be trained with an adaptive computerized program they called “speed training.” Through a number of NIH-funded studies, Drs. Ball and Roenker and their colleagues showed that speed training generalized to improvements in a variety of real-world measures, including on-road driving safety and timed instrumental activities of daily living. These results led to the inclusion of speed training in the ACTIVE study.

Q: Where is speed training now?
A: The inventors of speed training, Dr. Karlene Ball and Dr. Daniel Roenker, initially commercialized the product through a small business called Visual Awareness Inc. In 2007, as Posit Science began to build visual brain-training exercises, researchers from Posit Science met with Drs. Ball and Roenker to discuss collaborative opportunities. Those discussions led to the acquisition of the speed training program by Posit Science. Developers at Posit Science then worked closely with Drs. Ball and Roenker to port speed training from the original MS-DOS platform to modern computing platforms.

Q: Is this speed training available to the public?
A: Yes. The speed training exercise used in the ACTIVE study has been updated, and is now available as an exercise called Double Decision. Double Decision is one of the exercises in BrainHQ, an online cognitive training program from Posit Science. The exercise is patented, and is not available on any other website or program. DynamicBrain, based in Ottawa, Ontario, is the exclusive Canadian partner of Posit Science and provides Double Decision along with 28 other BrainHQ cognitive training exercises in English to Canadians and in French globally. To access "Double Decision" and « Double décision », people can subscribe at www.dynamicbrain.BrainHQ.com and www.dynamicbrain-fr.BrainHQ.com. A month-to-month subscription is $17 CAD (12 €), and an annual subscription is $120 CAD which works out to $10 per month (84 € which works out to 7 € per month). BrainHQ is also available as an iPhone or iPad, and dynamicbrain.brainhq.com is accessible from Android devices.

Q: What about other brain games? Do these results show that all brain games can reduce the risk of dementia?
A: There are dozens of brain training programs now available. In 2016, the FTC has been very actively enforcing existing consumer protection laws to stop brain game companies from making false advertisements and claims of efficacy. The ACTIVE study shows that speed training in particular reduces the risk of dementia, and that other forms of cognitive training do not. This means that any brain game or brain-training program that wants to state that it reduces the risk of dementia must go through a clinical trial like ACTIVE to establish that claim and a regulatory clearance process with the FDA. Posit Science has announced that it plans to seek clearance for this intended use from the FDA. Posit Science makes no claims at this time with respect to the efficacy of its offerings in preventing or treating any disease or disorder.

What’s Next?

Q: What role does the FDA have?

A: Posit Science plans to include this data as part of a medical device clearance (510(k)) application to the FDA.

Q: What research should be done next?
A: Key next research questions include:

- *Dosing:* ACTIVE showed that booster training drives a larger effect. How big could the effect be if people did boosters every year, instead of just twice? How about if the boosters were 10 hours of training? Or twenty? How about if the boosters involved different forms of speed training?
- *Combinations:* Would combining speed training with other plasticity-based training exercises yield a larger effect? Or combining speed training with physical exercise? How about a comprehensive brain health program, composed of speed training, physical exercise, and optimal diet/nutrition?
- *When:* How young should a person start brain training? How old is too late, or can the brain be improved at any age? Could speed training be effective in people already diagnosed with dementia?