<https://www.brainhq.com/longevityresponse>

**A Response to “A Consensus on the Brain Training Industry from the Scientific Community”**

On October 20, 2014, the Stanford Center on Longevity (the “Longevity Center”) released a statement presented as “A Consensus on the Brain Training Industry from the Scientific Community.” The statement is critical of the brain fitness industry, and given Posit Science’s leadership in that industry, I want to take the time to respond to it carefully.

I fundamentally agree with a basic thrust of the statement—no one should make science claims for brain training with little or no evidence, and no one should mislead the public about what the science shows by exaggeration or omission. And I also agree with the regrettable points raised by the statement that some companies in our nascent brain fitness industry engage in this type of marketing behavior.

Having said that, I strongly disagree with the claims in the statement that there is little or no evidence of efficacy of cognitive training. There are now more than 70 peer-reviewed papers about the benefits of the BrainHQ exercises from Posit Science. More than 50 of those papers focus specifically on the benefits of our cognitive exercises in aging (see [https://dev-bhq.pantheonsite.io/agingstudies](https://www.brainhq.com/world-class-science/published-research)). These studies have involved many thousands of research participants. Multiple scientific reviews and meta-analyses have confirmed these positive results. From this enormous body of scientific work, the Longevity Center statement mentions in passing only a single study, and the summary statement ignores the literature entirely. Regardless of whether this omission is intentional or an oversight, this is poor scientific practice, and it raises significant questions about the quality of their process.

The statement did make several good points about the scientific obligations of brain fitness providers. I’d like to highlight them, and note how Posit Science has lived up to these goals. At Posit Science, we strongly agree that:

1. *Consumers who want exercises that have been shown to work should expect companies to provide peer-reviewed, randomized, controlled trials:*At Posit Science, we say our programs work because they have been shown to work in dozens of such trials, including the three largest randomized controlled cognitive training trials ever conducted: the ACTIVE, IMPACT, and IHAMS trials.
2. *No one should say or imply products have scientific evidence where there is no or little evidence.*At Posit Science, every statement we make regarding the proven benefits of our cognitive training programs is rigorously analyzed by a team of scientists against a broad body of evidence, including more than 70 published peer-reviewed articles on the benefits of exercises we bring to market, to make sure that each statement is accurate.
3. *Such evidence is stronger if run independently.*Posit Science directly conducted the first two published studies of our cognitive training exercises, because we believed it was incumbent on us to jump-start the science of this field. With these two small exceptions, all of the more than 70 peer-reviewed publications using our exercises have been from studies run by independent academic scientists, typically funded by the National Institutes of Health.
4. *Better studies employ active controls.* Our studies are conducted with strong control or comparison groups. Control activities have included adult education (through computerized classes and quizzes), crossword puzzles, computer games, and, in the case of studies on the impact of exercises on driving abilities, drivers’ education classes.
5. *Studies have more weight when run at multiple sites or results are replicated in subsequent studies.* A large number of the studies on our exercises have been multi-site studies or have results that have been replicated. The three largest studies—ACTIVE, IMPACT, and IHAMS—were all run at multiple sites.

The statement also recommended four tests that brain training programs need to pass to be fully credible. At Posit Science, our programs have passed these four tests:

1. *Are the positive changes noticed in real life indices of cognitive health?*Yes. Our exercises are unique among what is available to the public, because there have been so many peer-reviewed demonstrations of generalization to real-life indices of cognitive health. These include better driving (e.g., at-fault crash risk reduced by 48%; 36% fewer dangerous on-road driving maneuvers; better ability to drive under a variety of challenges); better health outcomes (e.g., better scores on measures of health-related quality of life, including the SF-36 and SF-1, commonly used in VA and CMS studies, and 3.3% lower predicted healthcare costs, based on the use of the federal government’s model developed by AHRQ for DHS, and used by Medicare and Medicaid); better mood (e.g., 38% less risk of onset of depression; 30% less risk of deepening of depression; 68% greater feelings of control) better self-reported performance in a normed measure of everyday cognitive activities (e.g., remembering why you walked into a room; following a conversation in a noisy place); reduced fall and mobility risk; improved ability to hear in a noisy environment; and many, many others. Together, these results show that positive changes are not just on the training exercises themselves, but, crucially, are on real-life indices of cognitive health.
2. *Does the improvement encompass a broad array of tasks that constitute a particular ability, or does it just reflect the acquisition of specific skills?* The outcome measures in IMPACT encompassed two distinct composite measures of cognitive function, each composed of multiple standardized neuropsychological tests; the outcome measures in ACTIVE and IHAMS were broad measures of health-related quality of life and mood; and the outcome measures in ACTIVE additionally included real-world automobile crash measures. Together, these measures show improvements on a broad array of tasks that constitute generalized abilities.
3. *Do the gains persist for a reasonable amount of time?* Yes. IMPACT documented benefits persisting for three months after training, IHAMS showed persistence of at least one year, and ACTIVE has now shown that some benefits can last for ten years following training. In aggregate, it is now clear that cognitive training works like physical exercise—the benefits persist following training, and, absent further exercise, the effects diminish over time.
4. *What role do motivations and expectations play in bringing about improvements in cognition when observed?* Motivations and expectations are important, and can be controlled for by the use of active controls. IMPACT used an adult education control, IHAMS used crossword puzzles, and ACTIVE employed three different kinds of cognitive training. In the dozens of other published studies on Posit Science’s exercises, the lion’s share also included relevant active controls.

We also agree with the statement that brain fitness providers should be criticized for exaggerated or misleading claims in marketing their products. At Posit Science, we are working to build a brain fitness industry based on solid science and clinical evidence. We have a rigorous process for marketing claims and are receptive to a dialogue with anyone who has concerns about our claims.

Given the criticism of marketing language made by the statement, critics should take care not to engage in the same kinds of mistakes. And unfortunately, by ignoring or disregarding this published scientific literature, the Longevity Center statement misleads the public regarding the true status of scientific evidence for the efficacy of brain training.

In the spirit of promoting better science and better understanding of the science that has already been done, I offer two points of guidance to the Longevity Center for their use in future reviews:

1. *Comprehensive Data Review:*Any consensus statement that reviews the state of the science should include, at minimum, a comprehensive review and rating of the scientific publications that went into the analysis. Without this, it is not possible to distinguish facts from opinions, which is an essential goal of any review process. Future statements should follow best practices for scientific reviews, and include a list of publications reviewed, with a rigorous and transparent process (including a scoring scale describing how the evidence was evaluated and by whom, and a summary of the scores). For examples of how high-quality scientific reviews conduct and document their data gathering and analytic processes, Longevity Center coordinators should read this [review](http://www.plosone.org/article/info%3Adoi/10.1371/journal.pone.0040588#pone-0040588-g001) from Dr. George Rebok and colleagues, or this [review](http://scholar.google.com/scholar?cluster=6115676484717339599&hl=en&as_sdt=0,5&as_ylo=2010) from Drs. Nicola Gates and Michael Valenzuela, or this [review](http://www.ncbi.nlm.nih.gov/pubmed/22150209) from Dr. Elizabeth Zelinski and Shoshana Hindin. Each carefully gathers all relevant studies, evaluates the strength of the study and claims from the data, and then analyzes the data as a group. Each also documents positive effects from cognitive training using these very standard scientific review and meta-analytic approaches. Scientists, as well as the public, should be swayed by evidence, not advertising or opinions.
2. *Gathering Consensus:*Any consensus statement should seek input from all stakeholders, particularly, in this area, from neuroscientists who specialize in applied plasticity research. Without this, key knowledge and perspectives can easily be missed. Future Longevity Center reviews should involve representatives from industry, as well as academia. They should not claim to speak for the “scientific community” when there is clearly not a consensus across that community.

Why did the Longevity Center issue this flawed statement? Frankly, I don’t know. Despite our involvement with most of the published research showing efficacy in this area, we were not invited to participate. From my recent conversations with participants (some of whom signed the statement and some of whom refused to do so), I believe that the Longevity Center was primarily focused on the intensive television, radio, and internet-based advertising that has become common from some of our competitors. This wave of advertising has frustrated many scientists, perhaps leading to the Longevity Center statement. However, that frustration does not obviate the need to comprehensively review the evidence before drafting a statement, and does not excuse replacing scientific rigor with exaggerations, omissions, polemics, and press releases.

Companies in this space have to decide whether to spend their time, effort, and assets on studies and developing new science, or on marketing and advertising. From the start, our focus has been to make exercises that work, which requires advancing the science through good research. Other companies have focused on marketing and advertising. Regrettably, by ignoring the substantial research that has been done, the Longevity Center statement undermines companies in this nascent industry who genuinely care about and invest in science.  It also likely reinforces a belief, amongst others, that the investment of time and effort in science will only yield a return of endless academic debate.

At Posit Science, we believe it is important to look at evidence when coming to a scientific consensus, with a particular focus on evidence from new science that can help advance the field to a new plateau of understanding. Earlier in his career, our co-founder, Dr. Michael Merzenich, was among the first to show evidence of plasticity in the adult brain. The “scientific consensus” at that time was that plasticity ended with adulthood. Dr. Merzenich was pilloried for his early publications, and it literally took decades and hundreds of articles from Dr. Merzenich and others to move the so-called “consensus.” Now, virtually every introductory neuroscience textbook treats "lifelong" plasticity as an accepted fact. Dr. Merzenich was also considered outside the “consensus” for his early belief that it was possible to cure certain types of deafness with a neural prosthetic. His research on plasticity led to his co-invention of the cochlear implant—technology that has now helped give or restore hearing to hundreds of thousands of people. We are now going through this same process around the evidence for cognitive training—and we’re going to end up at the same place.

Mike Merzenich taught me as a young scientist to care more about what the right answer is than about “being right.” Discovery comes from adapting to new facts. These are the same values he inculcated at Posit Science, where we work with hundreds of university-based scientists around the world to invent new training regimens, test them and validate them—so we can get them out of the lab to people they can help. Our mission at Posit Science is not to maximize shareholder value or to make personal fortunes or reputations. Our mission is simply stated as “ Science to the people!” We hope others who are like-minded will join us in achieving that goal.

Is there more research to be done on cognitive training? Sure. The more, the better—and there are still some open questions. That’s why we have many more studies underway right now. But I am pleased to confirm that the first wave of evidence is already in—properly designed cognitive training programs do work—and well-run, independent, randomized controlled trials have shown it.

Henry W Mahncke, PhD
CEO, Posit Science

# Lumosity to Pay $2 Million to Settle FTC Deceptive Advertising Charges for Its “Brain Training” Program

### Company Claimed Program Would Sharpen Performance in Everyday Life and Protect Against Cognitive Decline[Linked-In](http://www.linkedin.com/shareArticle?mini=true&url=https://www.ftc.gov/news-events/press-releases/2016/01/lumosity-pay-2-million-settle-ftc-deceptive-advertising-charges&title=%27Lumosity%20to%20Pay%20$2%20Million%20to%20Settle%20FTC%20Deceptive%20Advertising%20Charges%20for%20Its%20%E2%80%9CBrain%20Training%E2%80%9D%20Program%27&summary=%27The%20creators%20and%20marketers%20of%20the%20Lumosity%20%E2%80%9Cbrain%20training%E2%80%9D%20program%20have%20agreed%20to%20settle%20Federal%20Trade%20Commission%20charges%20alleging%20that%20they%20deceived%20consumers%20with%20unfounded%20claims%20that%20Lumosity%20games%20can%20help%20users%20perform%20better%20at%20work%20and%20in%20school,%20and%20reduce%20or%20delay%20cognitive%20impairment%20associated%20with%20age%20and%20other%20serious%20health%20conditions.As%20part%20of%20the%20settlement,%20Lumos%20Labs,%20the%20company%20behind%20Lumosity,%20will%20pay%20$2%20million%20in%20redress%20and%20will%20notify%20subscribers%20of%20the%20FTC%20action%20and%20provide%20them%20with%20an%20easy%20way%20to%20cancel%20their%20auto-renewal%20to%20avoid%20future%20billing.%E2%80%9CLumosity%20preyed%20on%20consumers%E2%80%99%20fears%20about%20age-related%20cognitive%20decline,%20suggesting%20their%20games%20could%20stave%20off%20memory%20loss,%20dementia,%20and%20even%20Alzheimer%E2%80%99s%20disease,%E2%80%9D%20said%20Jessica%20Rich,%20Director%20of%20the%20FTC%E2%80%99s%20Bureau%20of%20Consumer%20Protection.According%20to%20the%20FTC%E2%80%99s%20complaint,%20the%20Lumosity%20program%20consists%20of%2040%20games%20purportedly%20designed%20to%20target%20and%20train%20specific%20areas%20of%20the%20brain.Lumosity%20has%20been%20widely%20promoted%20though%20TV%20and%20radio%20advertisements%20on%20networks%20including%20CNN,%20Fox%20News,%20the%20History%20Channel,%20National%20Public%20Radio,%20Pandora,%20Sirius%20XM,%20and%20Spotify.The%20FTC%20alleges%20that%20the%20defendants%20claimed%20training%20with%20Lumosity%20would%201)%20improve%20performance%20on%20everyday%20tasks,%20in%20school,%20at%20work,%20and%20in)

FOR RELEASE

January 5, 2016

The creators and marketers of the Lumosity “brain training” program have agreed to settle Federal Trade Commission charges alleging that they deceived consumers with unfounded claims that Lumosity games can help users perform better at work and in school, and reduce or delay cognitive impairment associated with age and other serious health conditions.

As part of the [settlement, Lumos Labs, the company behind Lumosity, will pay $2 million in redress](https://www.ftc.gov/system/files/documents/cases/160105lumoslabsstip.pdf)and will notify subscribers of the FTC action and provide them with an easy way to cancel their auto-renewal to avoid future billing.

“Lumosity preyed on consumers’ fears about age-related cognitive decline, suggesting their games could stave off memory loss, dementia, and even Alzheimer’s disease,” said Jessica Rich, Director of the FTC’s Bureau of Consumer Protection. “But Lumosity simply did not have the science to back up its ads.”

According to the [FTC’s complaint](https://www.ftc.gov/system/files/documents/cases/160105lumoslabscmpt.pdf), the Lumosity program consists of 40 games purportedly designed to target and train specific areas of the brain. The company advertised that training on these games for 10 to 15 minutes three or four times a week could help users achieve their “full potential in every aspect of life.” The company sold both online and mobile app subscriptions, with options ranging from monthly ($14.95) to lifetime ($299.95) memberships.

Lumosity has been widely promoted though TV and radio advertisements on networks including CNN, Fox News, the History Channel, National Public Radio, Pandora, Sirius XM, and Spotify. The defendants also marketed through emails, blog posts, social media, and on their website, Lumosity.com, and used Google AdWords to drive traffic to their website, purchasing hundreds of keywords related to memory, cognition, dementia, and Alzheimer’s disease, according to the complaint.

The FTC alleges that the defendants claimed training with Lumosity would 1) improve performance on everyday tasks, in school, at work, and in athletics; 2) delay age-related cognitive decline and protect against mild cognitive impairment, dementia, and Alzheimer’s disease; and 3) reduce cognitive impairment associated with health conditions, including stroke, traumatic brain injury, PTSD, ADHD, the side effects of chemotherapy, and Turner syndrome, and that scientific studies proved these benefits.

The complaint also charges the defendants with failing to disclose that some consumer testimonials featured on the website had been solicited through contests that promised significant prizes, including a free iPad, a lifetime Lumosity subscription, and a round-trip to San Francisco.

The proposed stipulated federal court order requires the company and the individual defendants, co-founder and former CEO Kunal Sarkar and co-founder and former Chief Scientific Officer Michael Scanlon, to have competent and reliable scientific evidence before making future claims about any benefits for real-world performance, age-related decline, or other health conditions.

The order also imposes a $50 million judgment against Lumos Labs, which will be suspended due to its financial condition after the company pays $2 million to the Commission. The order requires the company to notify subscribers who signed up for an auto-renewal plan between January 1, 2009 and December 31, 2014 about the FTC action and to provide a means to cancel their subscription.

The Commission vote authorizing the filing of the complaint and proposed stipulated order was 4-0, with [Commissioner Julie Brill issuing a separate concurring statement](https://www.ftc.gov/public-statements/2016/01/concurring-statement-commissioner-julie-brill-matter-lumos-lab-inc). The FTC filed the complaint and proposed order in the U.S. District Court for the Northern District of California, San Francisco Division.

The FTC is a member of the National Prevention Council, which provides coordination and leadership at the federal level regarding prevention, wellness, and health promotion practices. This case advances the National Prevention Council’s goal of increasing the number of Americans who are healthy at every stage of life. This case is part of the FTC’s ongoing efforts to protect consumers from misleading health advertising.

**NOTE:**The Commission authorizes the filing of a complaint when it has “reason to believe” that the law has been or is being violated, and it appears to the Commission that a proceeding is in the public interest. A stipulated order has the force of law when signed by the district court judge.

The Federal Trade Commission works to [promote competition](https://www.ftc.gov/about-ftc/bureaus-offices/bureau-competition), and protect and educate consumers. You can learn more about [how competition benefits consumers](https://www.ftc.gov/sites/default/files/attachments/competition-counts/zgen01.pdf) or [file an antitrust complaint](https://www.ftc.gov/faq/competition/report-antitrust-violation). Like the FTC on [Facebook](https://www.facebook.com/federaltradecommission), follow us on [Twitter](https://twitter.com/FTC), read our [blogs](https://www.ftc.gov/news-events/blogs/competition-matters) and [subscribe to press releases](https://www.ftc.gov/stay-connected) for the latest FTC news and resources.

<https://www.ftc.gov/news-events/press-releases/2016/01/lumosity-pay-2-million-settle-ftc-deceptive-advertising-charges>

<http://longevity.stanford.edu/a-consensus-on-the-brain-training-industry-from-the-scientific-community-2/>

(Other links not shown, but available here:

<https://www.theatlantic.com/science/archive/2016/10/the-weak-evidence-behind-brain-training-games/502559/>

<https://www.scientificamerican.com/article/brain-training-doesn-t-make-you-smarter/>

<https://www.sciencedaily.com/releases/2017/04/170417095528.htm>

<https://www.technologyreview.com/s/602540/brain-training-apps-wont-make-you-smarter/>

<https://www.cnn.com/2016/10/20/health/brain-training-exercises/index.html>

<https://www.learningrx.com/brain-training-101>

<http://www.latimes.com/business/hiltzik/la-fi-mh-if-you-weren-t-smart-enough-20160106-column.html> )

A Consensus on the Brain Training Industry from the Scientific Community (Full Statement)

October 20, 2014

As the baby boomers enter their golden years with mounting concerns about the potential loss of cognitive abilities, markets are responding with products promising to allay anxieties about potential decline. Computer-based cognitive-training software –popularly known as brain games– claim a growing share of the marketplace. The promotion of these products reassures and entices a worried public.

Consumers are told that playing brain games will make them smarter, more alert, and able to learn faster and better. In other words, the promise is that if you adhere to a prescribed regimen of cognitive exercise, you will reduce cognitive slowing and forgetfulness, and will fundamentally improve your mind and brain.

It is customary for advertising to highlight the benefits and overstate potential advantages of their products. In the brain-game market, advertisements also reassure consumers that claims and promises are based on solid scientific evidence, as the games are “designed by neuroscientists” at top universities and research centers. Some companies present lists of credentialed scientific consultants and keep registries of scientific studies pertinent to cognitive training. Often, however, the cited research is only tangentially related to the scientific claims of the company, and to the games they sell. In addition, even published peer-reviewed studies merit critical evaluation. A prudent approach calls for integrating findings over a body of research rather than relying on single studies that often include only a small number of participants.

The Stanford Center on Longevity and the Berlin Max Planck Institute for Human Development gathered many of the world’s leading cognitive psychologists and neuroscientists –people who have dedicated their careers to studying the aging mind and brain– to share their views about brain games and offer a consensus report to the public. What do expert scientists think about these claims and promises? Do they have specific recommendations for effective ways to boost cognition in healthy, older adults? Are there merits to the claimed benefits of the brain games and if so, do older adults benefit from brain-game learning in the same ways younger people do? How large are the gains associated with computer-based cognitive exercises? Are the gains restricted to specific skills or does general cognitive aptitude improve? How does playing games compare with other proposed means of mitigating age-related declines, such as physical activity and exercise, meditation, or social engagement?

The search for effective means of mitigating or postponing age-related cognitive declines has taught most of us to recognize the enormous complexity of the subject matter. Like many challenging scientific topics, this is a devil of many details. The consensus of the group is that claims promoting brain games are frequently exaggerated and at times misleading. Cognitive training produces statistically significant improvement in practiced skills that sometimes extends to improvement on other cognitive tasks administered in the lab. In some studies, such gains endure, while other reports document dissipation over time. In commercial promotion, these small, narrow, and fleeting advances are often billed as general and lasting improvements of mind and brain. The aggressive advertising entices consumers to spend money on products and to take up new behaviors, such as gaming, based on these exaggerated claims. As frequently happens, initial findings, based on small samples, generate understandable excitement by suggesting that some brain games may enhance specific aspects of behavior and even alter related brain structures and functions. However, as the findings accumulate, compelling evidence of general and enduring positive effects on the way people’s minds and brains age has remained elusive.

These conclusions do not mean that the brain does not remain malleable, even in old age. Any mentally effortful new experience, such as learning a language, acquiring a motor skill, navigating in a new environment, and, yes, playing commercially available computer games, will produce changes in those neural systems that support acquisition of the new skill. For example, there may be an increase in the number of synapses, the number of neurons and supporting cells, or a strengthening of the connections among them. This type of brain plasticity is possible throughout the life span, though younger brains seem to have an advantage over the older ones. It would be appropriate to conclude from such work that the potential to learn new skills remains intact throughout the life span. However at this point it is not appropriate to conclude that training-induced changes go significantly beyond the learned skills, that they affect broad abilities with real-world relevance, or that they generally promote “brain health”.

As we take a closer look at the evidence on brain games, one issue needs to be kept in mind: It is not sufficient to test the hypothesis of training-induced benefits against the assumption that training brings no performance increases at all. Rather, we need to establish that observed benefits are not easily and more parsimoniously explained by factors that are long known to benefit performance, such as the acquisition of new strategies or changes in motivation. It is well established, for example, that improvements on a particular memory task often result from subtle changes in *strategy*thatreflect improvement in managing the demands of that particular task. Such improvement is rewarding for players (the fun factor) but does not imply a general improvement in memory. In fact, the notion that performance on a single task cannot stand in for an entire ability is a cornerstone of scientific psychology. Claims about brain games often ignore this tenet. In psychology, it is good scientific practice to combine information provided by many tasks to generate an overall index representing a given *ability*. According to the American Psychological Association, newly developed psychological tests must meet specific psychometric standards, including reliability and validity. The same standards should be extended into the brain game industry, but this is not the state of affairs today.

To date, there is little evidence that playing brain games improves underlying broad cognitive abilities, or that it enables one to better navigate a complex realm of everyday life. Some intriguing isolated reports do inspire additional research, however. For instance, some studies suggest that both non-computerized reasoning and computerized speed-of-processing training are associated with improved driving in older adults and a reduction in the number of accidents. Another study revealed, for a sample of younger adults, that 100 days of practicing 12 different computerized cognitive tasks resulted in small general improvements in the cognitive abilities of reasoning and episodic memory, some of which were maintained over a period of two years. In other studies, older adults have reported that they felt better about everyday functioning after cognitive training, but no objective measures supported that impression. Additional systematic research is needed to replicate, clarify, consolidate, and expand such results. To be fully credible, an empirical test of the usefulness of brain games needs to address the following questions. Does the improvement encompass a broad array of tasks that constitute a particular *ability*, or does it just reflect the acquisition of specific skills? Do the gains persist for a reasonable amount of time? Are the positive changes noticed in real life indices of cognitive health? What role do motivation and expectations play in bringing about improvements in cognition when they are observed?

In a balanced evaluation of brain games, we also need to keep in mind opportunity costs. Time spent playing the games is time not spent reading, socializing, gardening, exercising, or engaging in many other activities that may benefit cognitive and physical health of older adults. Given that the effects of playing the games tend to be task-specific, it may be advisable to train an activity that by itself comes with benefits for everyday life. Another drawback of publicizing computer games as a fix to deteriorating cognitive performance is that it diverts attention and resources from prevention efforts. The promise of a magic bullet detracts from the message that cognitive vigor in old age, to the extent that it can be influenced by the lives we live, reflects the long-term effects of a healthy and active lifestyle.

We also must keep in mind that studies reporting positive effects of brain games on cognition are more likely to be published than studies with null results –the so-called “file drawer effect”– such that even the available evidence is likely to draw an overly positive picture of the true state of affairs. Statistical methods such meta-analysis, which integrates the results of many studies in a given field of inquiry, allow estimation of effect magnitude as well as the likelihood of the file-drawer effect. While some meta-analyses report small positive effects of training on cognition, others note substantial disparities in methodological rigor among the studies that cast doubt on any firm conclusion. Further, the problems that haunt individual studies do not simply disappear when results from such studies are summarized in a meta-analysis. In particular, the practice of assessing specific tests rather than broader assays of ability is just as problematic on the level of meta-analytic integration as it is on the level of individual studies.

In summary, research on aging has shown that the human mind is malleable throughout life span. In developed countries around the world, later-born cohorts live longer and reach old age with higher levels of cognitive functioning than those who were born in earlier times. When researchers follow people across their adult lives, they find that those who live cognitively active, socially connected lives and maintain healthy lifestyles are less likely to suffer debilitating illness and early cognitive decline in their golden years than their sedentary, cognitively and socially disengaged counterparts. The goal of research on the effectiveness of computer-based cognitive exercise is to provide experimental evidence to support or qualify these observations. Some of the initial results are promising and make further research highly desirable. However, at present, these findings do not provide a sound basis for the claims made by commercial companies selling brain games. Many scientists cringe at exuberant advertisements claiming improvements in the speed and efficiency of cognitive processing and dramatic gains in “intelligence”, in particular when these appear in otherwise trusted news sources. In the judgment of the signatories below, exaggerated and misleading claims exploit the anxiety of adults facing old age for commercial purposes. Perhaps the most pernicious claim, devoid of any scientifically credible evidence, is that brain games prevent or reverse Alzheimer’s disease.

In closing, we offer five recommendations. Some of these recommendations reflect experimental findings in human populations, whereas others are based on a synthesis of correlational evidence in humans and mechanistic knowledge about risks and protective factors.

* Much more research needs to be done before we understand whether and what types of challenges and engagements benefit cognitive functioning in everyday life. In the absence of clear evidence, the recommendation of the group, based largely on correlational findings, is that individuals lead physically active, intellectually challenging, and socially engaged lives, in ways that work for them. Before investing time and money on brain games, consider what economists call opportunity costs: If an hour spent doing solo software drills is an hour not spent hiking, learning Italian, making a new recipe, or playing with your grandchildren, it may not be worth it. But if it replaces time spent in a sedentary state, like watching television, the choice may make more sense for you.
* Physical exercise is a moderately effective way to improve general health, including brain fitness. Scientists have found that regular aerobic exercise increases blood flow to the brain, and helps to support formation of new neural and vascular connections. Physical exercise has been shown to improve attention, reasoning, and components of memory. All said, one can expect small but noticeable gains in cognitive performance, or attenuation of loss, from taking up aerobic exercise training.
* A single study, conducted by researchers with financial interests in the product, or one quote from a scientist advocating the product, is not enough to assume that a game has been rigorously examined. Findings need to be replicated at multiple sites, based on studies conducted by independent researchers who are funded by independent sources. Moreover, participants of training programs should show evidence of significant advantage over a comparison group that does not receive the treatment but is otherwise treated exactly the same as the trained group.
* No studies have demonstrated that playing brain games cures or prevents Alzheimer’s disease or other forms of dementia.
* Do not expect that cognitively challenging activities will work like one-shot treatments or vaccines; there is little evidence that you can do something once (or even for a concentrated period) and be inoculated against the effects of aging in an enduring way. In all likelihood, gains won’t last long after you stop the challenge.

*In summary: We object to the claim that brain games offer consumers a scientifically grounded avenue to reduce or reverse cognitive decline when there is no compelling scientific evidence to date that they do. The promise of a magic bullet detracts from the best evidence to date, which is that cognitive health in old age reflects the long-term effects of healthy, engaged lifestyles. In the judgment of the signatories, exaggerated and misleading claims exploit the anxiety of older adults about impending cognitive decline. We encourage continued careful research and validation in this field.*

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Citing this statement:

“A Consensus on the Brain Training Industry from the Scientific Community,”  Max Planck Institute for Human Development and Stanford Center on Longevity, accessed (add date), <http://longevity.stanford.edu/a-consensus-on-the-brain-training-industry-from-the-scientific-community-2/>

(There is also a summary statement at <http://longevity.stanford.edu/a-consensus-on-the-brain-training-industry-from-the-scientific-community/>)

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