CENTER *for* BRAINHEALTH®
THE UNIVERSITY OF TEXAS AT DALLAS

Brain Health in the Age of AI:

Reclaiming Your Agency

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The arrival of generative artificial intelligence (GenAI) and large language models (LLMs) has opened extraordinary possibilities for how we think, learn and create.

Used well, AI can expand human capacity by allowing us to offload rote tasks and direct our limited cognitive energy toward deeper reasoning, imagination and connection.

In this white paper, we aim to provide a larger, human context for thinking about how AI will influence brain performance. Our focus is not to alarm but to guide. There's no denying that AI is now part of the human experience.

We are not going to comment on whether AI will destroy employment or chatbots are going to take over the world. Our role at Center for BrainHealth is to consider the impact of AI on brain health and performance, and to do something about it.

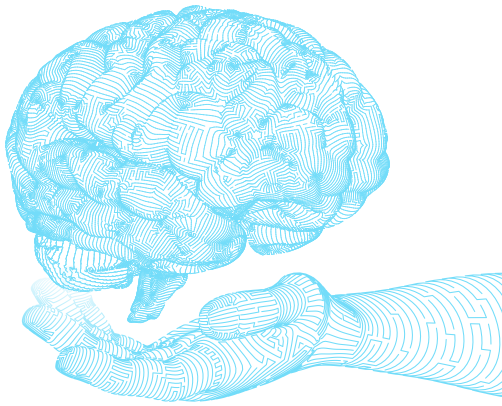
The key is to ensure that AI serves as a co-pilot to enhance your most valuable asset – your brain – and to retain your agency. Even in the midst of cognitive challenges, when you maintain your agency, AI does not deliver a story of decline.

The Brain: A Remarkable Control System

Biologically speaking, the mammalian brain is an information processing system, fueled by glucose metabolism and restored by sleep. Fundamentally, it is a control system — one that acts on the world with purpose and adapts based on outcomes. While it is a delightfully complex system, the unifying job description of all those neurons and glial cells is to better control actions in different circumstances.

This statement is intended to be broad: the brain's role extends to actively choosing and modifying those very circumstances. It even includes self-regulation — our ability to take steps that help preserve autonomous thinking is one of the brain's most important functions.

We can monitor our focus, regulate emotions, question assumptions, and direct our beliefs and behaviors toward long-term goals. This capability for self-direction, or agency, is rooted in our executive functions, higher-order cognitive skills that enable us to chart our own course in a world of competing demands and make each of us unique in our thinking and being. Agency allows us to grow by taking on challenges, allowing us to build and strengthen our sense of control.



Challenges Can Have Desirable Side Effects

What makes the human brain so extraordinary is not just its complexity, but its adaptability. With billions of neurons forming and reforming synaptic connections in response to experience, the brain is changing at every moment. This phenomenon, known as neuroplasticity, is a product of the nervous system's capacity to reorganize its structure and function in response to the changing demands placed upon it.

You shape your brain to perform better by continuously using and challenging the prefrontal cortex, the brain region most responsible for executive functions like planning, reasoning and inhibitory control. Grappling with challenges modifies your neural architecture, strengthening the very circuits required for complex thought. Research from Center for BrainHealth has demonstrated this directly: healthy adults who participate in strategy-based cognitive training have shown a 7.9% increase in global cerebral blood flow. This provides physical evidence that cognitive challenge restructures the brain[1]. But this change is not instant.

Perhaps the term that best captures this approach is *desirable difficulty*. To learn from experience, to mature and truly flourish, the growth process requires productive challenges with desirable difficulty[2]. If something comes too easily, it's less likely to be remembered and mastered. Like bones and muscle, human control systems get stronger through load-bearing exercise and resistance training. However, much like excessive strain can damage a muscle, excessive challenge can lead to frustration and stress.

Challenges need to be developmentally and skill-level appropriate, requiring just enough effort to stretch capabilities but not so much that it becomes overwhelming. What's required for optimal growth is what psychologist Lev Vygotsky called the *zone of proximal development*: that sweet spot where challenge slightly exceeds current ability and guidance bridges the gap[3].

By persevering through the grind, you cannot help but draw on and engage self-regulation. Life demands that you manage a range of human experiences, including volatility, uncertainty, complexity, ambiguity, anxiety, distraction, temptation, boredom. Self-regulation is a skill; it can be learned. You can choose to impose on yourself the necessary conditions for strengthening it. When you go outside your comfort zone and persist through desirable difficulty, you make that zone larger.

From the perspective of Center for BrainHealth, expressing your full humanity means taking on desirable difficulties. Your brain won't function optimally without this challenge, and you won't develop your own unique perspective and depth. Harnessing desirable difficulty helps you create a rich life and as you develop into someone who is thoughtful, efficacious, confident and interesting.

While the output your brain produces could be something that AI can do a thousand times faster, working through the problem to find your own solution is necessary for brain health and performance. If you're not taxing your brain to solve complex problems or produce meaningful solutions, your brain is effectively declining.

Technology Changes the Brain (and the Body)

Before we bring AI into the picture, we need to understand that many technologies impact how the brain or body functions.

THREE EXAMPLES OF THIS PATTERN:

WRITING

Reduced the demands placed on memory

Before writing, communities relied on oral tradition, and the brain had to store vast amounts of knowledge. With written language, memory became externalized. The need for extreme memory capacities reduced, but it also freed cognitive resources for more complex problem solving.

GPS

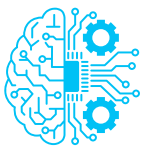
Reduced the demand on spatial abilities

Classic studies of London taxi drivers show enlarged posterior hippocampi, reflecting the cognitive map required by those who use spatial memory every day[4]. GPS offloads the need to form those mental maps, giving people fewer opportunities to engage their spatial abilities. However, this isn't necessarily catastrophic: it reflects the brain's adaptability to redirect resources.

LABOR-SAVING DEVICES

Reduced the demand on physical exertion

These innovations increased efficiency but contributed to sedentary lifestyles that negatively influence cardiovascular, metabolic, and brain health. In response, we created gyms to compensate for the reduced physical demands of modern life.



Technology consistently shifts the brain-body workload by removing certain demands and creating opportunities for new engagement. But as in the case of labor-saving devices, we must think critically about how we continue to exercise our minds and bodies.

Emerging Evidence: Cognitive Tradeoffs

We can now ask the key question: How will AI enhance and/or derail a self-regulating, multi-dimensional control system, one that is not engineered but nurtured? The research community has begun answering this question. And the early findings demand our attention.

You Change How You Engage Your Brain

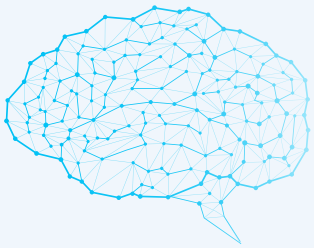
In a preliminary study at the MIT Media Lab, researchers used electroencephalography (EEG) to track neural activation while participants wrote SAT-style opinion essays.

Those using ChatGPT showed reduced activity in neural networks associated with cognitive control, working memory and creative synthesis.

Additionally, LLM users became progressively less cognitively engaged, resorting to copy-and-paste tactics by the study's end[5].

83% of LLM users could not quote from the essays they had just written a few minutes earlier, suggesting impaired encoding into their long-term memories.

These early findings align with what we know about neuroplasticity: the brain adapts to the cognitive demands we place upon it.

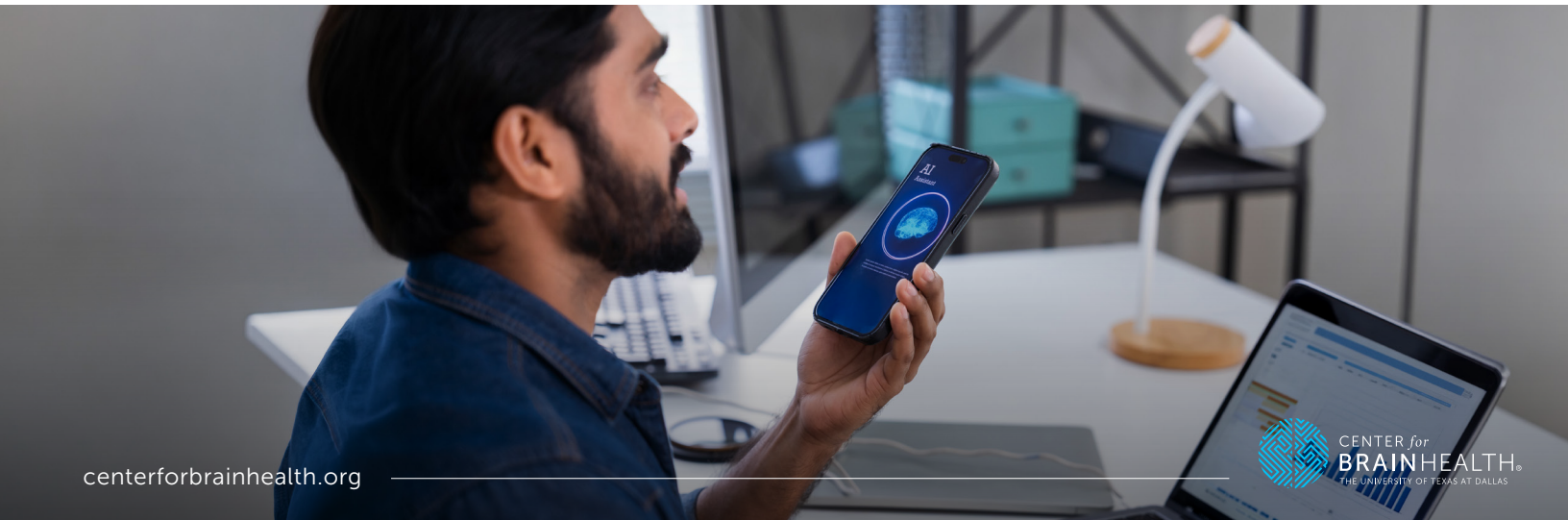


Active Reasoning Erodes as Trust in AI Increases

A study by Microsoft Research and Carnegie Mellon University surveyed 319 knowledge workers and found a troubling confidence relationship: the more you trust AI's abilities, the less likely you are to think critically about its outputs. GenAI shifts thinking from active reasoning toward passive verification[6].

Separately, a study across five North American universities found that STEM students who trusted and routinely used GenAI reported significantly lower cognitive engagement, less reflection, less need for understanding, and less critical thinking[7].

Paradoxically, the students most prone to cognitive disengagement were those with the highest technological confidence — a mindset typically celebrated in STEM education, but risky when paired with lack of critical thinking. Prior experience with AI and academic seniority did not appear to offer any protection.



A Self-Reinforcing Cycle of Delegation

These aren't isolated findings. They point to what researchers investigating cognitive processes shaping human-AI interactions at Oregon State University are calling a "cognitive debt cycle," where routine AI use weakens the intellectual habits required for independent thought, making AI feel even more necessary as its continued use further weakens cognitive capacity and personal agency[7]. Similarly, researchers at the Machine Human Intelligence Lab, an independent research project focused on comprehensively evaluating cognitive capabilities in AI systems, have observed a related pattern, which they have labeled "the delegation feedback loop." As AI capacity grows exponentially, the ability for humans to sustain attention may be shrinking in parallel, according to preliminary evidence. Less attention leads to more delegation to AI, which leads to less human practice, which loops back around to less attention[8].

Another proposed framework by researchers evaluating human-AI collaboration draws the distinction between *cognitive amplification* where AI improves performance while preserving human expertise) and *cognitive delegation*, (where reasoning skills are progressively outsourced, a AI-reliant behavior that risks) long-term atrophy[9]. Which path you are on is not determined by the technology. It is determined by you. Will you choose to engage actively with AI as a thinking partner, or passively accept its outputs as a substitute for your own reasoning?

Deskilling Is Already Happening

In medicine, a systematic review found that AI-driven decision support systems erode clinical expertise over time by reducing opportunities for skill acquisition[10]. In education, a randomized controlled trial found that undergraduates with unrestricted ChatGPT access performed substantially worse on assessments administered weeks later, because they bypassed the self-quizzing and note-taking essential for knowledge consolidation[11]. Microsoft researchers found the same pattern in secondary schools: students using AI-generated notes perceived tasks as easier but demonstrated weaker retention[12].

*The paradox is clear: **AI raises short-term productivity** while potentially **eroding the expertise** on which those productivity gains depend[13].*

Ideas Are Beginning to Converge

Creativity emerges when the default mode network (DMN), which supports self-referential processing, autobiographical memory and spontaneous thought, dynamically couples with the prefrontal cortex to evaluate, select and recombine information in novel ways. Each idea is uniquely generated, shaped by the individual's lived experience and cognitive architecture.

By contrast, LLMs generate outputs by predicting statistically likely token sequences based on training data, converging toward the most probable output rather than the most original. A landmark study published in *Science Advances* demonstrated this experimentally: Writers given AI-generated ideas produced stories that were individually rated as more creative, but those stories were significantly more similar to each other[14].

The result is a social dilemma of individual gain paired with collective loss, in which AI improves the perceived quality of individual work while collectively narrowing the scope and novelty of the content produced. In engineering education, AI-assisted design teams generated ideas faster but experienced premature convergence, narrowed exploration, and compromised functional quality. Human-only teams engaged in more iterative experimentation and produced designs reflecting higher quality of ideas and greater diversity[15].

Can we use creativity to measure value added by humans in an AI-driven world?

Researchers at Georgetown are working to quantify the ongoing idea space expansion by mapping how original an idea is relative to human or AI patterns of thinking.

> We can identify when an idea lies within or beyond the patterns AI produces. In practice, mapping idea space reveals the tempting but hazardous black-holes of AI homogenization. Once we can see them, we can steer clear, and the best way to do that is to stretch your creativity to add distinct value beyond AI. Another benefit is that, when people see how their own ideas extend beyond what AI can achieve, that builds self-efficacy and provides a way for them to measure their creative growth.
>
> - Adam Green, PhD
> Georgetown University

The Risk to the Models Themselves

The consequences of this convergence extend beyond individuals. When human-generated output homogenizes at scale, the systems that train on human behavior will follow.

LLMs are not reasoning systems in any cognitive sense. They are extraordinarily sophisticated pattern-completion engines, trained via next-token prediction (repeatedly guessing what comes next and adjusting based on accuracy). They make predictions based on datasets drawn from the full range of recorded human expression – literature, scientific research, computer programming, legal arguments, philosophical debates and varied forms of informal discourse – implicitly encoding the structure of human reasoning: how arguments are built, how problems are solved, and how ideas are connected. Interactions with capable models feel cognitively substantive not because the model reasons, but because the training data is densely populated with instances of human reasoning.

The seeming fluency of an LLM in executive function tasks – planning, synthesis, evaluation, creative generation – is a reflection of the totality of human cognitive output.

Researchers have already documented what happens when the quality of training data degrades. When iteratively retrained on model-generated data, AI generates less varied and original output, causing measurable performance degradation: tail distributions collapse, outputs converge – the rare ideas, creative leaps and dissenting perspectives that gave models their apparent breadth become progressively less visible[16].

Researchers have termed this phenomenon "model collapse," and it is an active area of concern in model development. What has not been part of that conversation is the upstream behavioral interaction: humans generating (or recycling) the content that feeds those pipelines may also be converging toward AI-patterned outputs as a result of repeated cognitive offloading. If humans using AI converge on the same ideas, and those ideas populate the content that trains future models, the diversity that made AI valuable narrows from both ends simultaneously[12].

The causal chain from individual cognitive offloading to population-scale degradation of training data quality has not yet been empirically demonstrated at that scale. However, this structural risk is likely to be accelerated by observed trends and behavioral patterns.

This concern is not limited to language models. Virtually every generative system in production today – image and video generation models, code generation models, multimodal systems – is trained on human-created content and produces outputs that increasingly populate the same ecosystems that models will learn from next. Domain-specific examples of the same underlying pattern are visible across systems – in the aesthetic homogenization of AI-generated imagery, the convergence of AI-generated code patterns in public repositories, and the flattening of recommendation signals (data points used to predict human behavior) collected as AI dominates the content ecosystem.

> *Brain-healthy AI adoption is both about protecting individual cognitive performance and preserving the quality of the human cognitive output that the next generation of AI systems will depend on.*

The Unexamined Risk: Social Cognition

There is a dimension of brain health that current AI research has almost entirely overlooked: social cognition, the capacity to read others, navigate ambiguity in conversation, regulate emotions in real-time interaction, and build meaningful connection.

Social cognition is itself a desirable difficulty. Learning to interpret nonverbal cues, manage conversational uncertainty, take another's perspective, and assert yourself in a group are skills that require practice under real social pressure. They depend on many of the same prefrontal networks involved in executive function and creative thought[1].

We are witnessing a shift in how people connect. Real human relationships, with all their friction, unpredictability and vulnerability, are increasingly being replaced by AI interactions. People confide in chatbots, seek advice from AI companions, and report feeling genuinely understood by systems designed to simulate empathy. This is not inherently bad. AI is designed to feel natural, and there's nothing wrong with feeling supported. But important questions must be considered.

When a conversation with AI feels easier than a conversation with a person, what happens to your willingness to navigate the challenges of making human contact? When an AI validates you without challenge, what happens to your tolerance for disagreement? When social friction is removed — navigating misunderstandings, overcoming

awkwardness, the effort of truly hearing someone — what happens to the social muscles that grow only through the desirable difficulty of that friction?

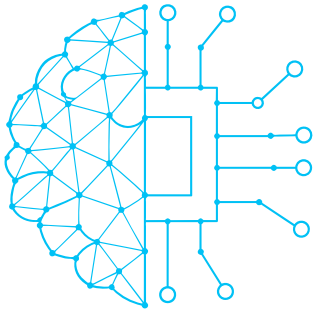
AI is increasingly mediating social interaction in subtler ways too. Messages are drafted by AI. Meetings are summarized by AI. Conflict is navigated by asking a chatbot how to respond. Each of these conveniences removes an opportunity to practice the social reasoning that keeps our social brains sharp. If the cognitive offloading pattern we see in critical thinking and creativity also applies to social cognition — and we have no reason to believe it wouldn't — then AI may be eroding our capacity for human connection in ways we haven't yet measured.

Early data supports this concern. A 12-month longitudinal study of over 2,000 adults across four countries observed a bidirectional relationship: emotional isolation predicted increased AI companion use, which in turn predicted *further* emotional isolation — a social cognition parallel to the cognitive debt cycle[17].

At Center for BrainHealth, our research on social brain health predates the AI era but positions us to measure exactly this effect. Through our IASSERRT™ assessment, delivered via the Charisma™ virtual social training platform, we have developed validated measures of social assertion, perspective-taking and communicative effectiveness in immersive environments [18,19]. IASSERRT captures how individuals navigate social complexity in real time: whether they can assert their ideas, read social cues, regulate emotional responses, and adapt their communication under pressure. This research demonstrates that social skills can be measured precisely, trained effectively and improved, even in adolescent populations where social cognition is still developing[20].

The question now is whether AI-mediated communication is producing a social deskilling analogous to the cognitive deskilling already being demonstrated. Are people who rely on AI for social navigation losing the capacity to navigate on their own? Is the *connectedness* dimension of brain health declining as real human interaction becomes increasingly optional?

Measuring Connectedness requires longitudinal tools validated in tracking social skills and brain health outcomes. Our IASSERRT™ assessment and Charisma™ training environment position us to do exactly that.



The Story Is Not All About Decline: AI Literacy for Brain Health

The pattern emerging from both sets of findings is not that AI is inherently harmful or helpful, but that the outcome depends on how it is used and who is using it.

Emerging evidence paints a concerning picture, but it is only half complete. The same research community that has documented AI's risks has also documented its genuine benefits.

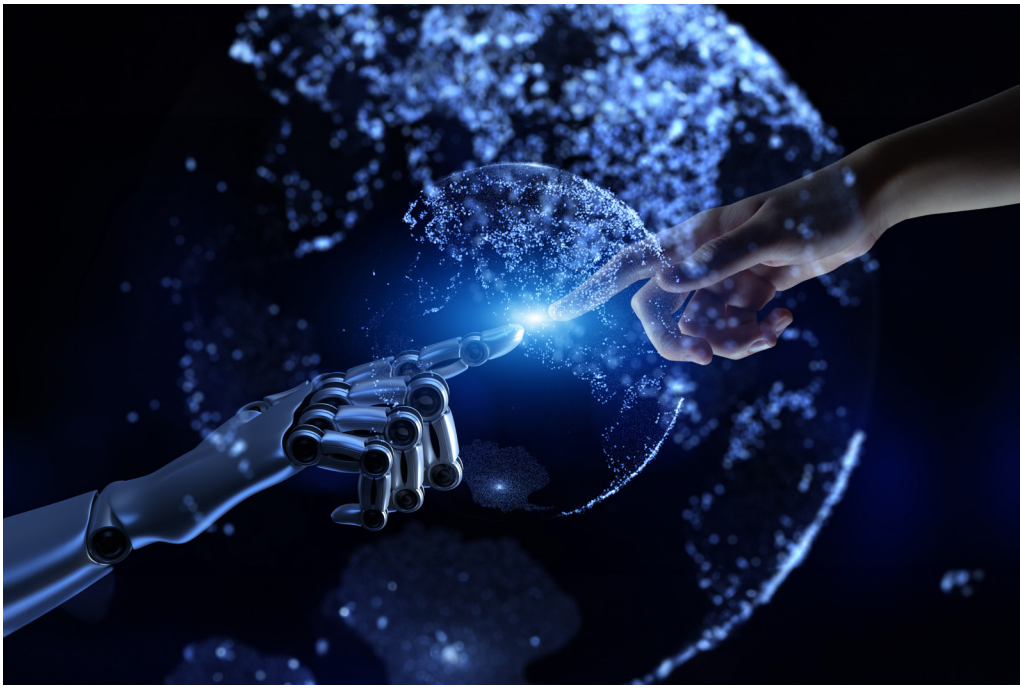
We refuse to be alarmists. The evidence is clear that AI *could* harm brain health, but equally clear that it doesn't have to. When used intentionally, as a collaborator rather than a replacement, AI has been shown to boost productivity, accelerate learning, and enhance creative output. The research on the potential benefits is just as rigorous as the research on the risks.

AI Can Accelerate the Learning Curve

In a natural experiment with over 5,000 customer support agents, AI assistance increased productivity – measured by number of chats successfully resolved per hour – by 15% on average, and by 30% for novice and low-skilled workers[21]. In a randomized experiment of more than 1,100 adults completing a workplace-style business problem-solving task, AI improved the content and quality of participants' work, with the largest gains among those with less formal education. For example, AI assistance increased correct identification of the problem's root cause from 50% to 84% among lower-education participants, compared with 65% to 88% among those with higher education, nearly eliminating the gap.[15]

Human-AI Collaboration Outperforms Either Alone

A meta-analysis across multiple creativity studies found that humans collaborating with GenAI can significantly outperform those working alone, with a moderate effect size (Hedges' g = 0.27, indicating a meaningful and consistent advantage)[23]. Separate research confirms that human-AI collaboration remains superior to AI-AI, underscoring the irreplaceable role of humans in the idea space[24]. For experienced designers, AI elevates quality and refinement. For novices, it facilitates idea generation[25]. The benefits depend on what you as the user bring to the interaction – and how intentional you are about how you use AI tools.



AI Can Strengthen Learning

A meta-analysis of AI-based educational interventions found positive effects on self-regulated learning across cognitive, motivational and behavioral dimensions when AI is designed to support self-regulation rather than bypass it[26]. Researchers have proposed the "cognitive mirror" framework, where AI reflects a learner's thinking back to them rather than serving as an omniscient oracle[27]. When AI is designed to provoke reflection rather than deliver answers, metacognition stays engaged.

Research also shows that when *cognitive offloading* is strategic, freeing resources for meaningful activities, it supports adaptive coping and emotional regulation. The outcome depends entirely on whether offloading is intentional or habitual[28].

The distinction is not whether you use AI. It's how you use it.

The Core Argument: AI Is a Tool Your Brain Is Not Optional

Every technology in history has shifted the brain-body workload. Writing has reduced memory demands. GPS has reduced spatial demands. Labor-saving devices have reduced physical demands. In each case, new technology has freed humans to redistribute their cognitive capacity, but also created risks when people stop exercising the skills that have been offloaded to AI.

AI is following the same pattern, but at unprecedented scale and speed. What previously unfolded over years — like the widespread adoption of GPS — is now happening in a matter of months. And unlike previous technologies, AI now aims to emulate executive functions themselves: higher-level skills that humans must retain and oversee, like reasoning, planning, critical evaluation and creative synthesis.

THE RESEARCH TELLS US THREE THINGS:

1. **When AI replaces thinking, brains decline.** Neural activity decreases, critical thinking erodes, expertise atrophies, and ideas homogenize [5, 6, 7, 10, 14].

2. **When AI amplifies thinking, people flourish.** Productivity rises, creativity improves, learning curves accelerate, and the combination outperforms either alone [21, 22, 23, 24].

3. **The difference is agency.** Individuals with strong executive functioning use AI as a strategic co-pilot. Those without default to AI as a substitute for thinking, and the gap widens [6, 7, 9].

This is why brain health and performance matter now more than ever. The future won't be determined by who has access to AI (because everyone will), but by who has the cognitive agility to use it wisely.

You Can Delegate or Develop

In the United States, we already have a significant divides across health, income and connectedness, and the AI age risks adding a further inequality: an executive functioning divide.

Individuals with strong executive functioning skills are far more likely to use AI intentionally and strategically. With this approach, AI becomes a multiplier: strong brain health enables humans to use AI agentically, which strengthens higher-order thinking and creative through a virtuous cycle driven by judgment.

For individuals leaning into AI to boost executive functioning, the effect may go in the opposite direction. Without behavioral patterns that create agency and self-regulation, these users are at heightened risk of defaulting to AI as a substitute for thinking. An emerging body of research shows that over time dependency on artificial intelligence weakens the cognitive abilities required to use AI strategically. Diminished confidence, lower cognitive endurance, and a growing gap in brainpower emerge in a vicious cycle of AI reliance.

At Center for BrainHealth, we're extremely concerned that a significant portion of the population will simply become less cognitively capable in an AI world – not because AI is malicious, but because it always offers an easy path, encouraging overuse despite the risks to cognitive health.

When you outsource too much, you weaken the capacities that enable you to thrive. Without intentional use or guidance, those at risk of becoming dependent on AI are likely to do so at an accelerating pace.

The empty stairs and crowded escalator illustrate the temptation to let AI take the easier path for us — potentially leaving our cognitive capacities underused.

Four Brain-Healthy Practices for Navigating the AI World

We believe strong brain health is the best defense and offense in the AI era – so we propose four practices to reclaim and strengthen your cognitive agency:

Learn the basics of neuroscience young and continuously. Understanding how the brain works, and practicing desirable difficulty, will be essential to developing fundamental brain skills for life. When you know that challenge is the mechanism of growth, you stop avoiding it.

Disengage strategically. Spend time away from AI building your own personal database. Connect with others, experience new things, be bored, reflect deeply. These moments shape your subjective experience and enhance your self-confidence as you experiment in the world.

Use AI as a co-pilot, not a decision-maker. Balance offloading rote tasks to AI while reserving desirable difficulty for yourself. Originate ideas yourself before handing them over to AI to improve. Use AI to refine, not to replace your thinking.

Reflect wisely. Pay attention to how you are using AI. Do you feel challenged to expand your thinking with its help? Self-reflection on your AI use will further build your capacity for sustained attention and problem solving.

We Are Not Standing Idly By

The evidence is accumulating. The questions are sharpening. And at Center for BrainHealth, we are entering this conversation not as observers but as active participants.

For nearly thirty years, we have studied how the brain performs, how it declines, and how it recovers. We developed the BrainHealth Index, a validated, holistic measure of cognitive performance spanning reasoning, emotional balance, social connectedness, and clarity of thought[29]. In a landmark three-year study of nearly 4,000 adults aged 19 to 94, we demonstrated that brain performance can improve at any age, with the greatest gains in those who most actively engaged in strategy-based training and brain-healthy practices[30]. We created SMART™ (Strategic Memory Advanced Reasoning Tactics) cognitive training strategies, validated across military populations with traumatic brain injury, corporate teams, education settings, and community programs [31,32]. Through our Adolescent Reasoning Initiative™ we have trained over 600 educators and reached more than 100,000 students.

Now, we are bringing all of this to bear on the defining cognitive challenge of our era.

What Center for BrainHealth Is Doing

We are launching a longitudinal research study tracking how AI use patterns correlate with brain health outcomes over time. We are classifying users into typologies (non-user, novice, moderate, strategic) and measuring relationships between AI engagement and cognitive performance using the BrainHealth Index as the tracking tool. Built on the infrastructure of The BrainHealth Project, a 100,000-participant, decade-long study measuring brain health across the lifespan[32], this new study will provide the evidence base the world needs. Not assumptions about what AI might do to us, but measured data on what it actually does.

We are building a User's Manual for Your Brain in the AI Age. We are updating the guide to understanding and optimizing your brain manual for a world where AI is a constant cognitive partner. What should you offload? What should you never delegate? When does AI help your brain grow, and when does it let your brain decay? We intend to answer these questions with data, not opinion.

We are developing BrainHealthy AI Agents, AI tools designed from the ground up to strengthen rather than replace human thinking. These are not productivity tools. They are cognitive health tools: systems that provoke reflection, support metacognition, track your cognitive engagement, and ensure you remain the pilot of your own craft.

We are measuring the social dimension through IASSERRT [18, 19]. As AI increasingly mediates social interactions and substitutes for human companionship, we are positioned to detect and address social cognitive deskilling before it becomes entrenched. IASSERRT measures whether people can still navigate the real thing: asserting ideas, reading ambiguity, managing conflict, and connecting authentically under social pressure.

We are measuring the economic impact through Brainomics™, our framework for quantifying the return on investment in cognitive readiness. The argument for brain-healthy AI adoption is both a health-related and economic. Organizations that invest in cognitive resilience will outperform those that simply automate and hope for the best.

We Already Know How to Protect the Brain

Research on AI's cognitive effects is new. The science of neuroplasticity is not.

For nearly three decades, we have studied how the brain reorganizes itself in response to what we ask of it, and what we stop asking of it. The principle is consistent: circuits that are challenged grow stronger; circuits that are bypassed grow weaker. This is not metaphor. It is measurable structural and functional change, visible in blood flow, white matter integrity, and network connectivity.

What this means for AI is straightforward. The prefrontal networks responsible for reasoning, creative synthesis, and self-regulation are not fixed capacities. They are use-dependent systems. When AI removes the demand on these systems, when it does the reasoning, generates the ideas, and makes the decisions, those systems receive less activation. Less activation means less maintenance. Less maintenance means decline.

But plasticity works in both directions. The same mechanisms that allow decline also allow recovery and growth. We have demonstrated that adults at any age can increase cognitive performance, including measurable increases in cerebral blood flow, when they engage in strategy-based cognitive challenges [1, 30]. The brain does not have to weaken in response to AI. It weakens only when we let AI replace the engagement that sustains it.

Armed with what we already know about neuroplasticity, we know how to protect ourselves. We know that cognitive demands must be preserved for the brain to maintain its architecture. We know that intentional engagement, choosing when to delegate and when to do the hard thinking yourself, is the difference between amplification and atrophy. And we know that these patterns can be trained, practiced, and strengthened at scale.

We have translated this neuroscience into a structured approach, designed specifically for how people actually use AI in their work and daily lives. It is not a set of restrictions. It is a set of practices that keep the brain's use-dependent systems active while still leveraging everything AI offers.

Think of this approach as cognitive fitness for an AI-powered world: not anti-AI, but pro-brain.

As our longitudinal research matures and we learn more about the specific dose-response relationships, how much AI offloading is too much, which cognitive domains are most vulnerable, and which interventions are most protective, this approach will sharpen. The neuroscience foundation is the accumulated evidence of decades of work on how brains adapt, how they decline, and what we can do to tip the balance toward growth.

Why This Matters Now

The research window is closing. As AI becomes ubiquitous, the opportunity to establish baselines and track change narrows. The studies cited in this paper are early, small samples, short timeframes and mostly studying students. The field needs what we are uniquely positioned to provide: a large-scale, long-term, validated investigation of AI's effects on human brain health across diverse populations.

Our role in this emerging field is grounded in what we have already built: a validated instrument for measuring cognitive change (the BrainHealth Index), nearly thirty years of cognitive training science to build interventions from, a virtual social training platform for measuring social cognition (IASSERRT/Charisma™), and a lognitudianl study designed to track 100,000 adults over a decade. (The BrainHealth Project). Whether these tools can detect and characterize the specific cognitive effects of AI use is precisely what our longitudinal AI study is designed to answer. We bring these capabilities to bear on the defining question: What is the User's Manual for Your Brain in an age when AI can do your thinking for you?

We are asking. And we are building the answer.

Conclusion

Brain skills aren't optional. They're the necessary interface for navigating AI. And like any skill, they can be trained.

Used unreflectively, AI can take over the very systems that make us human. When we let it do all the thinking for us, we risk weakening our executive functioning, the brain's control system for reasoning and creativity, and collectively narrowing the diversity of ideas as everything starts to look and sound the same.

Used intentionally, AI becomes the most powerful cognitive co-pilot humans have ever had. It accelerates learning, enhances collaboration, and frees mental bandwidth for the deep, creative, distinctly human work that no machine can replicate.

The competitive differentiator in an AI world will not be who has the best tools. Everyone will have those. It will be who has the strongest brain, the clearest thinking, the deepest creativity, the most resilient agency.

Be the pilot of your own craft. Your unique experience and creativity will be your greatest advantage in this AI world.

You can choose to take on desirable difficulties. You have the potential for agency; claiming that inheritance, owning it, bringing it to maturity here and now, might feel like work. It can also feel like purpose or vitality, unexpected energy, lightness, and forward motion.

We are not standing idly by while this plays out. We are measuring it, we are studying it, and we are building the tools to ensure that the age of AI is also the age of brain health.

Sources

[1]Bjork, R.A. & Bjork, E.L. (2011). Making things hard on yourself, but in a good way: Creating desirable difficulties to enhance learning. In M.A. Gernsbacher & J. Pomerantz (Eds.), *Psychology and the Real World* (pp. 56-64). Worth Publishers.

[2]Maguire, E.A., Gadian, D.G., Johnsrude, I.S., Good, C.D., Ashburner, J., Frackowiak, R.S.J. & Frith, C.D. (2000). Navigation-related structural change in the hippocampi of taxi drivers. *Proceedings of the National Academy of Sciences*, 97(8), 4398-4403.

[3]Kosmyna, N., Hauptmann, E., Yuan, Y.T., Situ, J., Liao, X-H., Beresnitzky, A.V., Braunstein, I. & Maes, P. (2025). Your brain on ChatGPT: Accumulation of cognitive debt when using an AI assistant for essay writing task. MIT Media Lab. arXiv:2506.08872.

[4]Lee, H-P., Sarkar, A., Tankelevitch, L., Drosos, I., Rintel, S., Banks, R. & Wilson, N. (2025). The impact of generative AI on critical thinking: Self-reported reductions in cognitive effort and confidence effects from a survey of knowledge workers. *Proceedings of the 2025 CHI Conference on Human Factors in Computing Systems*. Microsoft Research / Carnegie Mellon University.

[5]Choudhuri, R., Sanchez, C.A., Burnett, M. & Sarma, A. (2026). Thinking less, trusting more: GenAI's impacts on students' cognitive habits. Oregon State University. arXiv:2601.22430.

[6]Eliav, N. (2026). The cognitive divergence: AI context windows, human attention decline, and the delegation feedback loop. Machine Human Intelligence Lab. arXiv:2603.26707.

[7]Di Santi, E. (2026). Cognitive amplification vs cognitive delegation in human-AI systems: A metric framework. arXiv:2603.18677.

[8]Natali, C., Marconi, L., Dias Duran, L.D., Miglioretti, M. & Cabitza, F. (2025). AI-induced deskilling in medicine: A mixed-method review and research agenda for healthcare and beyond. *Artificial Intelligence Review*, 58, 252. Springer.

[9]Barcaui, A. (2025). ChatGPT as a cognitive crutch: Evidence from a randomized controlled trial on knowledge retention. *Social Sciences & Humanities Open*, 12, 102287.

[10]Kreijkes, P., Kewenig, V., Kuvalja, M., Lee, M. et al. (2025). Effects of LLM use and note-taking on reading comprehension and memory: A randomised experiment in secondary schools. Microsoft Research. Available at SSRN.

[11] Caosun, M. & Aral, S. (2026). The augmentation trap: AI productivity and the cost of cognitive offloading. arXiv:2604.03501.

[12]Doshi, A.R. & Hauser, O. (2024). Generative AI enhances individual creativity but reduces the collective diversity of novel content. *Science Advances*, 10, eadn5290.

[13]Tsakalerou, M., Akhmadi, S., Balgynbayeva, A. & Kumisbek, Y. (2026). AI-assisted design synthesis and human creativity in engineering education. *Frontiers in Artificial Intelligence*.

[14]Brynjolfsson, E., Li, D. & Raymond, L. (2025). Generative AI at work. *Quarterly Journal of Economics*, qjae044. (Originally NBER Working Paper 31161, 2023.)

[15]Cruces, G., Fernandez Meijide, D., Galiani, S., Gálvez, R.H. & Lombardi, M. (2026). Does generative AI narrow education-based productivity gaps? Evidence from a randomized experiment. NBER Working Paper 34851.

[16]Holzner, N., Maier, S. & Feuerriegel, S. (2025). Generative AI and creativity: A systematic literature review and meta-analysis. arXiv:2505.17241.

Sources (continued)

[17]Li, C., Marjieh, R., Hu, H., Steyvers, M. & Griffiths, T.L. (2026). Human-AI synergy supports collective creative search. arXiv:2602.10001.

[18]Wang, N., Kim, H., Peng, J. & Wang, J. (2025). Exploring creativity in human-AI co-creation: A comparative study across design experience. *Frontiers in Computer Science.*

[19]Achuthan, K. (2025). Artificial intelligence and learner autonomy: A meta-analysis of self-regulated and self-directed learning. *Frontiers in Education.*

[20]Tomisu, H., Ueda, J. & Yamanaka, T. (2025). The cognitive mirror: A framework for AI-powered metacognition and self-regulated learning. *Frontiers in Education.*

[21]Chirayath, G., Premamalini, K. & Joseph, J. (2025). Cognitive offloading or cognitive overload? How AI alters the mental architecture of coping. *Frontiers in Psychology*, 16, 1699320.

[22]Chapman, S.B., Aslan, S., Spence, J.S., Keebler, M.W., DeFina, L.F., Didehbani, N., Perez, A.M., Lu, H. & D'Esposito, M. (2016). Distinct brain and behavioral benefits from cognitive vs. physical training: A randomized trial in aging adults. *Frontiers in Human Neuroscience*, 10, 338.

[23]Allen, T.T., Ashmore, L., Gordon, S., Tate, A., Cook, L.G. & Chapman, S.B. (2020). Charisma™: A virtual reality training to promote social brainhealth in adults. In A. Ferrante (Ed.), *Social Skills Across the Life Span* (pp. 295-309). Elsevier.

[24]Johnson, M., Tate, A.M., Tate, K., Laane, S., Chang, Z. & Chapman, S.B. (2022). Charisma™ Virtual Social Training: A digital health platform & protocol. *Frontiers in Virtual Reality*, 3, 1004162.

[25]Johnson, M.T., Troy, A.H., Tate, K.M., Allen, T.T., Tate, A.M. & Chapman, S.B. (2021). Improving classroom communication: The effects of virtual social training on communication and assertion skills in middle school students. *Frontiers in Education*, 6, 678640.

[26]Chapman, S.B., Fratantoni, J.M., Robertson, I.H., D'Esposito, M., Ling, G.S.F. et al. (2021). A novel BrainHealth Index prototype improved by telehealth-delivered training during COVID-19. *Frontiers in Public Health*, 9, 641754.

[27]Cook, L.G., Spence, J.S., Chang, Z., Venza, E.E., Tate, A., Robertson, I.H., D'Esposito, M., Ling, G.S.F., Wigginton, J.G. & Chapman, S.B. (2026). Measuring and increasing the brain health span across adulthood: A public health imperative. Nature Scientific Reports.

[28] Young, L.R., Rule, G., Lundie, M., Zientz, J., Terrell, K.H., Van Vleet, T., Tate, A.M. et al. (2025). Cognitive training to increase resilience. *Military Medicine*, 190 (Supplement_2), 640-648.

[29]Cook, L.G., Spence, J.S., Venza, E.E., Tate, A., Robertson, I.H., D'Esposito, M. et al. (2025). The BrainHealth Project study protocol: A scalable digital approach to measuring and promoting multidimensional brain health across the lifespan. *Frontiers in Human Neuroscience*, 19, 1678165.

[30] Folk, D. & Dunn, E. (2026). How does turning to AI for companionship predict loneliness and vice versa? *Psychological Science.*

[31]Young, L.R., Rule, G., Lundie, M., Zientz, J., Terrell, K.H., Van Vleet, T., Tate, A.M. et al. (2025). Cognitive training to increase resilience. Military Medicine, 190(Supplement_2), 640-648.

[32]Cook, L.G., Spence, J.S., Venza, E.E., Tate, A., Robertson, I.H., D'Esposito, M. et al. (2025). The BrainHealth Project study protocol: A scalable digital approach to measuring and promoting multidimensional brain health across the lifespan. Frontiers in Human Neuroscience, 19, 1678165.