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Exploring and Debunking the Myth of Improved Memory and Learning through Commercial Nootropics

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Abstract

Naturally-derived nootropics have been used throughout human history in order to induce physiological responses. Herbal brain supplements have gained increasing popularity in the past two decades, however, the promise of a "brain pill" is marred by pseudo-scientific research that conflates actual neuroscience and exaggerates the benefits of individual ingredients with the promise that a person can change their own cognitive functioning through a pill. This study reviews nootropic literature in the areas of science, business, and law, with a focus on (a) the dearth of legitimate scientific research supporting nootropic use; (b) the underlying health safety issues of nootropics marketers promoting products that are unsafe and even counterproductive; and (c) the lax regulations that facilitate the deception of consumers.

Keywords: nootropic, neurogenesis, memory, neuroscience, cognition, education

Introduction

With a market size 23 times larger than the coffee industry (Grand View Research, 2022), herbal brain supplements have gained increasing popularity in the past two decades. The reason for this growth is not because natural herbs have never been previously used. The market growth, rather, is due to scientific findings being exaggerated by unscrupulous manufacturers that make product claims unsupported by science.

Because people use herbal brain supplements in order to maximize their learning, it is important to dispel the "brain pill" myth because (a) despite little backing in legitimate scientific research, the use of herbal nootropics continues to steadily increase, at least in part due to lax regulation; and (b) many of these herbal brain products are actually unsafe and counterproductive.

Myth Origins and Context

What Are Nootropics?

Nootropics refers to ingested compounds purported to facilitate "learning and memory, or easing symptoms of natural or induced cognitive disorders. Nootropics are classified as a type of central nervous system modulator, acting as *antiamnesiacs* in cooperation with the neurological processes underlying memory storage" (Hamilton, 2014: 5-6; Malik, et al., 2007:124).

Brain research (Camfield, et al, 2014:185) discovered that spatial working memory is "a cognitive domain that has a high degree of sensitivity to pharmaceutical intervention and is one of the first domains to be adversely impacted by age-related cognitive decline." This research concluded that some natural compounds (such as ginseng and Ginkgo biloba) can increase "inhibitory neural processes" (Camfield, et al, 2014:185), that is, some ingested herbs can stimulate brain activity in the prefrontal brain regions that control a person's working memory.

Although the term *nootropic* (from the Greek "mind tuning") was coined by the Romanian chemist Corneliu Giurgea in the 1972, naturally-derived nootropics have been touted as early as people has utilized spices and other natural herbs to induce desired physiological responses (Hamilton, 2014:1).

In the industrial era, coffee, tea, tobacco, and sugar helped mentally and physically stimulate workers in the 18th and 19th centuries (Mintz, 1985). In the late 20th and early 21st centuries, "advances in the cognitive and neurosciences have been accompanied by demand for and development and proliferation of 'smart drugs,' 'brain boosters,' and other cognitive enhancers (Hamilton, 2014:1).

People who see advertisements for brain boosting pills are motivated by the fear of losing out in life because they are not maximizing their brain power. "Nootropics are marketed as a method of treating career stagnation, educational failure, and cognitive disease. The imagined effects of nootropics are suggestive of success as perceived by consumers in an information-based economy" (Hamilton, 2014:8).

There are three categories of nootropics within the dietary supplement arena—acetylcholine supplements, natural/herbal enhancers, and racetams (Hamilton, 2014). Because the focus of this paper is on the educational promises of herbal nootropics, this discussion will be limited to commercially-sold natural enhancers. For the purpose of this paper, *herbal brain supplements* and *nootropics* will be used interchangeably.

Neurogenesis Takes Hold in Society

After President George Bush declared the 1990's the "Decade of the Brain," (Tiffany, 2012:3).medical research started to focus on verifying that the adult human brain can produce neurons from primitive cells, a process called neurogenesis (Gage, 2002). Prior to this, it was thought that neurons could not be could not be regenerated after a certain point of development (Hamilton, 2014).

In the 21st century, popular culture through the media has become aware of the concepts of brain mapping and imaging. People began to see the possibility, supported by neuroscientific research, that that individuals could take a proactive role in their own brain power. As Rose & Abi-Rached (2014:6) explained, "In the context of an economy increasingly dependent on brain power… neuroscience was implicating how individuals managed their daily life."

The arising era of brain self-management has been coined *transhumanism*, or "an interdisciplinary approach to understanding and evaluating the opportunities for enhancing the human condition and the human organism opened up by the advancement of technology" (Bostrom, 2003:3). A major tenet of Transhumanism is that "that our brain shapes who we are, [and] that we have the power to shape our brains through

conscious decision making" (Rose and Abi-Rached, 2014:6).

Popular Culture

Storytelling, myth, and mass media advertising abound with stories of enhanced cognitive performance resulting from ingestion of powerful substances (Hamilton, 2014). Examples in entertainment include the *mélange spice* in the 1965 book *Dune* and the *modafinil* pill in the 2011 film "Limitless."

Because of persistent and targeted marketing, nootropic use is highest among university students, medical professionals, and the elderly (Hamilton, 2014).

Prevalence of the Myth in North America

With a 40% global revenue market share, North America is the largest international consumer of herbal nootropics. Because of the robust trade between the two countries as well as their shared media (mostly US-produced), Canada and the US have very similar nootropic markets. Reasons for the rise of nootropics in North America include

• Increasing numbers of domestic manufacturers
• Changing demographics (i.e., more elderly) and the related rise in society's focus on health
• An expanding public awareness of nootropics, driven primarily by targeted media marketing

Perpetuation of the Myth

The "brain pill" myth is perpetuated by manufacturers who strive to convince potential customers "that the human brain without supplementation is suboptimal" (Hamilton, 2014:26). Marketing strategies for herbal nootropics "offer manipulation of every cognitive function" and promise to both (a) enhance cognitive power; and (b) avoid neural decline (Hamilton, 2014:26). One nootropic marketer, for example, claims that their product is "formulated to supply several of the best nootropics for brain regeneration," [which] implies brain degradation has already occurred" (Hamilton, 2014:26).

Research and Status of the Myth

That an herbal supplement will significantly improve one's cognitive power remains a myth that is pervasive and dangerous. This section will discuss

1. The current status of the myth, including the increasing use of nootropics, even among medical professionals
2. Three reasons why the "brain pill" myth is untrue
3. The myth's impact on learning and education

Current Status of the Myth

Despite any scientific research that back nootropic products' claims of efficacy, their use continues to increase. Nootropic market growth is less a factor of consumer health than it is about financial opportunity for the nootropic manufacturers. This problem is exacerbated by a regulatory system that does little to protect consumers of commercial nootropics.

Increasing Use of Nootropics

According to current research, nootropics use among university students, medical professionals, and the elderly is steadily increasing. "The cultural, social, and political conditions driving consumption increases include but are not limited to medical and non-medical university formats, care received by cognitive declining elderly, and great faith in neurotechnology (Hamilton, 2014:10).

Studies show that 35% of college students reported using a non-prescription nootropic (Wilens, et al., 2008), with higher use among students with lower GPA's (Looby, et al., 2015). Studies conducted on nootropic consumption by healthcare professionals found that "use begins in medical school and continues into professional practice" (Hamilton, 2014:9). One study found that 8.9% of surgeons self-reported as using prescription and non-prescription nootropics in order "to counteract fatigue and loss of concentration" (Franke, et al., 2013:8). And a

cross-institutional study found that 11% of medical school students used psychostimulants; this study, interestingly, also indicated that fewer first year students used psychostimulants (Emanuel, et al., 2013), which might imply that nootropic use among medical professionals is a learned habit.

Research like those mentioned above has raised ethical questions about nootropic use in the medical field. Proponents suggest promoting nootropic use among healthcare professionals, "claiming it would save as many lives as technologically possible" (Greely, et al., 2008:704). Psychostimulants have even been suggested as a legal requirement for surgeons, in an attempt "to avoid fatigue-related errors" (Goold & Maslen, 2014:63).

Financially-Driven

Since the passing of the 1994 Dietary Supplement Health and Education Act (DSHEA), which allows dietary supplements to be marketed without FDA approval, dietary supplement sales have more than quadrupled (Crawford, 2020; Nichter, 2006). By 2016 in the US alone, the annual nootropic market was worth US$445 billion, dwarfing the annual coffee industry value of US$19 billion (Cheshire, 2014; Quidmat, 2016; Wild, 2005).

Why the Myth is Untrue

The brain boosting pill myth has been promulgated by marketers exaggerating actual scientific research. The truth is that many naturally-growing nootropics individually do work. The problem is, however, that although many individual ingredients in herbal nootropics are beneficial to brain health, the myth that herbal brain pills will boost cognitive power is untrue (and dangerous) for three reasons:

1. Product and formulations that are ineffective, or at worse, dangerous
2. Over-hype by marketers and social media influencers
3. Lack of industry regulation

What Really Works?

There is a plethora of scientific feedback on herbal nootropics, hardly any of it positive. Examples from Illuminate Labs' Cook & Graber (2022:2) include:

- We recommend that consumers entirely disregard claims of clinical efficacy based on manufacturer-funded research that is not published in peer-reviewed journals
- We only consider one of the ingredients to be effectively dosed
- We strongly disagree with the clinical claims made by the brand
- We would recommend avoiding all [of this company's] products
- We do not recommend any [of this company's] products, and we recommend avoiding this brand entirely

In her brain supplement research, Crawford (2020:1) explained that "scientific-sounding claims made are not supported by science." As an example, one can refer to Shmerling's (2021:1) discussion on claims by the manufacturers of Prevagen®:

Like many heavily-advertised supplements, this one makes many claims. The bottle promises it "improves memory" and "supports: healthy brain function, sharper mind, clearer thinking." Never mind that the main ingredient in jellyfish (apoaequorin) has no known role in human memory, or that many experts believe supplements like this would most likely be digested in the stomach and never wind up anywhere near the brain.

Do You Know What You Are Taking?

In her research paper entitled "A Public Health Issue: Dietary Supplements Promoted for Brain Health and Cognitive Performance," Crawford (2020) investigated 12 products marketed for brain health and found that

- 8 (67% of the products) had at least one ingredient listed on the Supplement Facts label that was not detected through analysis
- 10 (83% of the products) contained compounds not reported on the label
- 8 (67% of the products) contained an ingredient that was over 200% for % daily values (% DV), with the largest reported DV at 10,416%.

Moreover, many herbal nootropics contain added ingredients that are proven to have adverse health effects, including:

1. Sugar. Graber & Cook (2002:4) shared in their nootropic product review article, "A Harvard medical review established that excess sugar has a negative impact on brain function, so we consider two forms of added sugar to be questionable ingredient inclusions for a brain performance supplement." Not only do nootropics frequently not contain the expected ingredients, added sugar actually impedes brain function and is therefore a counterproductive ingredient.

2. Citric acid. Another inactive ingredient found in nootropics is citric acid, which functions as a preservative. There is, however, medical evidence that "some individuals experience whole-body inflammation in response to citric acid consumption," which is why citric acid is recommended to be avoided (Graber, et al., 2023:2).

3. Titanium dioxide. The inactive ingredient titanium dioxide can be found in nootropics such as Neuriva®. Titanium dioxide has "been banned in the European Union (E.U.), which has much stricter consumer protection laws than the U.S., for concerns over genotoxicity (the potential to damage DNA)" (Graber & Cook, 2022:2)

Weighing the Risks

In 2022, the American Medical Association warned in a press release,

Only a limited amount of information is available on the patterns of dietary supplements and herbal substances used for cognitive enhancement. More than 100 substances from amino acids to botanical preparations are advertised on websites as having the ability to improve cognitive performance, and their safety and efficacy have not been systematically examined.

Herbal nootropics vary in perceived effectiveness and known adverse reactions. Take for example gingko biloba, one of the more common primary ingredients in herbal nootropics. There is "debate on the cognitive enhancement capabilities of gingko. However, several studies suggest there are modest benefits including neuroprotection and memory recall" (Hamilton, 2014:7). Gingko, however, "has other effects including anticoagulant properties, causing it to affect the vascular system and contraindicate several prescription medications, creating a danger especially to the elderly" (Gold, et al., 2002:5).

A nootropic review in *The Jerusalem Post* (2022:7) concluded, "If you are looking for something that can give you an edge in the current competitive workspace, [a brain pill] may not be it."

Natural Solutions that Do Work

In contrast to the unsupported claims by nootropic sellers, there is substantive research on the brain-boosting benefits of flavonoids, which are found in berries. "Blueberries, strawberries, and raspberries are also powerful foods for learning and memory" (Lombardi, 2021:4), says Barbara Shukitt-Hale, PhD, a neuroscientist at the Jean Mayer USDA Human Nutrition Research Center on Aging at Tufts University in Boston. According to Shukitt-Hale's research, older adults eating the equivalent of one cup of fresh blueberries every day for three months did better on learning and memory tests than those who were given a placebo.

"Ongoing research suggests that strawberries and raspberries may have similar benefits, she says." (Lombardi, 2021:4). A 20-year study of older

women found that a "higher intake of flavonoids, particularly from berries, appears to reduce rates of cognitive decline in older adults," or in other words, "eating blueberries at least once a week or strawberries at least twice a week may delay cognitive aging by up to two-and-a-half years" (Devore, 2012:1).

Over-Hype

In his 2012 pamphlet entitled "Neuromythology: A Treatise Against the Interpretational Power of Brain Research," Haster "chastised scientists for affixing 'neuro' to dozens of fields of study in an effort to make them sound both sexier and more serious, as well as legitimate neuroscientists for contributing to 'neuro-euphoria' by overstating the import of their own studies. Most of all, he criticized the media:"

"Hardly a week goes by without the media releasing a sensational report about the relevance of neuroscience results for not only medicine, but for our life in the most general sense," Hasler wrote. And this fervor, he argued, had given rise to popular belief in the importance of "a kind of cerebral 'self-discipline,' aimed at maximizing brain performance." To illustrate how ludicrous he found it, he described people buying into brain fitness programs that help them do "*neurobics* in virtual brain gyms" and "swallow *neuroceuticals* for the perfect brain" (Tiffany, 2012:4; Haster, 2012).

The nootropic industry is notorious for using exaggerated product claims relying upon on pseudo-science. Such puffery can manifest in the form of (a) product labelling; and (b) media advertising, including with celebrity spokespeople.

Labelling

Analyzing the product labels of the 12 brain supplements, Crawford (2020:8-9) found that just one of the products' labels was free of "questionable" claims such as:

- Boost the function of your brain and memory
- Memory booster to help you retain information and recall it with greater ease
- Uncover your true mental potential
- Elevate your mental performance
- Igniting acute mental focus and fueling endurance

Crawford (2020:1) concluded, "There are dietary supplements targeting brain health being marketed to consumers that should be considered adulterated and misbranded. Advertisements and product labels maybe deceiving and could put the public at risk."

Marketers use information about their customers in order to convey their messages in targeted and methodological ways. Gillet (2007:3) studied how modern science and related technologies are referenced in nootropic promotions "because of the immense socio-cultural importance of those in the profession." Using linguistic devices like *grammaticalization* (language fitting the mode of discourse) in conjunction with *lexicalization* (a linguistic shift in form), as follows:

The [advertising] line begins with grammaticalization – a techno-scientific description of the product ("Increasing the rate of transfer of impulses on the brain synapses…"). The line ends with a more casual description of how [the nootropic] acts on the brain, hence lexicalization ("…would mean better and faster memory formation and recall") (Hamilton, 2014:24).

Dubious Regulation

Product labels for non-pharmaceutical nootropics in the US are regulated by the Federal Drug Administration (FDA), while the Federal Trade Commission (FTC) concentrates on advertising. There are qualified health claims, nutrient content claims, and structure/function claims. In dictating the construction of claim types, however, "these agencies are not exact in prohibiting words and phrases, rather they offer parameters around the type of research, and methods used to base claims off such research" (Hamilton, 2014).

The FTC and FDA are authorized to take legal action against dietary supplement companies. "Consequences for companies not adhering to labeling and advertising laws include the seizing of products and monetary profit generated, and the recommendation of criminal prosecution" (Hoffmann & Schwartz, 2016:68; Hamilton, 2014:13).

The Dark Side of Advertising

Brain supplements primarily target

• The elderly, who are concerned about cognitive decline
• Healthy adults, such as students and military, seeing to optimize their cognitive performance (Crawford, 2020).

Because of the health dangers, previous depictions of brain supplements in literature and film have now taken a disturbing turn in social/mass media as marketers promise better brain health from using their herbal nootropics.

Especially regarding nootropics, there is a rift between the interests of consumers and the manufacturers who sell to them. In a less sinister way, for a long time, marketers have realized that "natural" labeling "evokes positive feelings and sentimental imagery associated with a pastoral view of nature" due to contemporary "naïve naturalism," that is, viewing the earth as a human source of strength and renewal (Clinton et al., 2014:69).

Consumers who are skeptical of orthodox medicine can be open to alternative medicine (Jones, 2017). Marketers tap into that alternative/homeopathic sentiment by associating herbal medicine "with a shared ritual or alternative social venue" (Gopaldas, 2014:158). Hamilton (2014:22) summarized, "The semiotic reality of the nootropic industry, as constructed in marketing materials, is a reterritorialized space where consumers can assert cognitive agency in a culture separated from nature and disillusioned with orthodox medicine."

In large part, nootropics companies can get away with misleading advertising by using terms like "clinically-tested" instead of "clinically-proven," although the average audience will conflate the two (which is what marketers want them to do). In her research on 12 herbal brain supplements, Crawford (2020:9-10) explained

• 11 (92% of the products) had scientific-sounding claims reported either on the product bottle or on the manufacturer websites advertising the product. Examples of these scientific-sounding claims are o Clinically proven

o Contains only ingredients that have been validated by clinical studies
o Proven to provide brain function support
o Formulation built off of real science
o Best, most scientifically researched ingredients
o Research suggests it works the first time you take it

• None of the manufacturer websites on the product packages cited or provided any published, peer-reviewed research on their specific products.

Crawford (2020:10) expanded that, although herbal brain supplement manufacturers frequently reference peer-reviewed research on ingredients listed on the Supplement Facts labels, "it is questionable whether this literature has been validated for the specific claims made and the dose and administration presented, or in combination with the other ingredients listed… [in order] to understand relative safety and/or efficacy/effectiveness."

Dr. Gary Wenk, Professor of Psychology & Neuroscience & Molecular Virology, Immunology and Medical Genetics at the Ohio State University and Medical Center; and who also was a research scientist at The University of Arizona's Division of Neural Systems, Memory & Aging for 15 years, explained the psychological pull of nootropic advertising (2020:2-3):

There are no miracles on the brain-enhancement product shelf. The question is why people still fall for this pseudoscience? The answer is simple: People turn to dubious products because science has failed to invent a true brain enhancer. In addition, marketers learned long ago that their elixirs sell better if they originate from plants and are accompanied by vague claims.

Your mind plays a major role in how [nootropics] affect you. We all want to believe that the pills we take will help us feel and function better—and thanks to the poorly under-stood phenomenon of the placebo effect, we do sometimes, but only for a while, benefit even from the most bogus elixirs. Essentially, we want these drugs to do something, anything—so we fool ourselves into thinking that they do. After all, you just spent a lot of money on this supplement.

The FDA Steps In

Despite their deceptive advertising, several herbal nootropics companies have been successfully prosecuted for misleading advertising. Television actor Mayim Bialik was recently a pivotal witness in the case again Neuriva®. In her ads

A. Bialik states "I'm an actual neuroscientist" [although Bialik earned a PhD in neuroscience, she has never worked as a neuroscientist nor has she published any peer-reviewed research], and "I love the science of Neuriva" (Hall, 2021:2)
B. Relying on viewers' acceptance of her as an expert on brain health, Bialik goes on to assert, "Neuriva Plus is backed by strong science—yes, I checked it myself—and it combines two clinically tested ingredients that help support six key indicators of brain health." Neuriva has not been clinically tested, instead relying "on studies of individual ingredients, and those studies are questionable" (Hall, 2021:2).

In the Neuriva® case, plaintiffs presented in court how Mayim Bialik used her PhD in neuroscience in order to misrepresent Neuriva's efficacy.

In a related case, in 2021 the company that sells Prevagen® lost a class action lawsuit based on the claim that the company falsely stated that its products are "clinically shown to improve memory." They had to pay out $36 million (Gombossy, 2022:3).

Is Regulation Helping? Still Promoted, But Now "Clinically-Tested"

Although a few of the major US herbal nootropic producers have been called to account for their misleading advertising, any significant impact on those producers' future practices is dubious. Truth in Advertising (2022:2-3) breaks down why the Neuriva® settlement is unfair to consumers:

1. The settlement only requires the manufacturer to stop using the word "proven." This permits the company to use misleading claims like "tested" (i.e., "clinically-tested") and "backed by real science"

a. The company is only required to make these marketing changes for two years
b. The company could still make its false claims until six months after a federal judge gave final approval of the settlement

2. While individual Neuriva® consumers can each claim $20 from the settlement ($65 if they have purchase receipts), the plaintiff's attorneys pocketed $3 million

3. The settlement forever blocks consumers from ever suing that manufacturer again in the future

Resistance to the Myth

Clarke et al. (2003) posited that techno-scientific discourses in marketing, media, and culture contribute to the expansion of *medicalization*, that is, when nonmedical problems become defined and treated as medical problems that require treatment. Nootropic adverting campaigns are intentionally designed to medicalize, that is, to increase consumer's thirst to self-manage an imagined weakness in their cognitive functioning. When the advertising is effective, customers are compelled to self-treat that perceived brain deficit through nootropics. Ironically, people who are

convinced they are lagging in cognitive functioning often will ignore the science (or most precisely, the lack thereof) and instead gravitate toward anecdotal tales of success to convince themselves that a brain pill is the solution.

Impact on Learning and Education

The myth (that memory and learning can be greatly enhanced by ingesting commercial nootropics) presents two main problems related to learning and education. First, nootropic marketing campaigns aggressively target students by convincing them that their brain function is suboptimal without them receiving herbal supplementation. Second, even medical professionals – starting while in medical school – are increasingly using nootropics themselves.

Despite (a) an utter lack of scientific support for most brain supplement claims; and (b) the inherent dangers of ingesting a product of dubious production quality, there appear to be no guardrails (medical, legal or professional) to slow the misinformed surge in herbal nootropic use.

The findings summarized in this report can serve to inform teachers and educators so that they can incorporate their knowledge of nootropics into their class instruction and one-to-one mentoring so that their students can be aware of the brain pill myth and thus avoid the pitfalls of pursuing something "too good to be true."

Conclusion

In the quest for profit, sellers of herbal nootropic brain supplements promise their customers will have improved focus, memory, concentration, learning, accuracy and reasoning – claims that have never been scientifically proven. Pseudo-scientific research conflates actual neuroscience and exaggerates the benefits of individual ingredients with the promise that a person can change their own cognitive functioning through a pill.

Taking advantage of a regulatory system that fails to protect nootropic consumers, marketers' exaggerated claims will most likely continue to grow (along with their profits). Besides the fact that customers are buying a basically useless product, there is substantial danger to nootropic users because of (a) poor quality control at the production level; (b) mislabeled packaging; and even (c) ingredients that are either (i) dangerous for some people to ingest; and/or (ii) (as in the case of added sugar) actually impede cognitive function.

Students—and the public in general—would be well served to (a) be more aware of the actual lack of science behind herbal nootropics; (b) watch out for misleading advertising like "backed by science;" and (c) know that the lack of production quality standards can pose actual health risks to users of herbal nootropics.

Conflict of Interest Statement

The authors declare that there is no conflict of interest.

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