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**Marketplace of memory: What the brain fitness technology industry says about us,
and how we can do better**

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Abstract

In the therapeutic void created by over twenty failed Alzheimer's disease drugs during the past decade, a new marketplace of "brain fitness" technology products has emerged. Ranging from video games and computer software to mobile phone apps and hand-held devices, these commercial products promise to maintain and enhance the memory, concentration, visual and spatial skills, verbal recall, and executive functions of individual users. It is instructive to view these products as socio-cultural objects deeply imbued with the values and ideologies of our age; consequently, this article offers a critique of the brain fitness technology marketplace, while identifying limitations in the capacity of commercial products to realistically improve cognitive health. A broader conception of brain health is presented, going beyond the reductionism of the commercial brain fitness marketplace and asking how our most proximate relationships and local communities can play a role in supporting cognitive and psychosocial wellbeing. This vision is grounded in recent experiences at The Intergenerational School in Cleveland, Ohio, a multi-generational, community-oriented learning environment that is implementing brain fitness technology in novel ways.

Key words: cognitive training, Alzheimer's disease, dementia, brain health,

The story of brain aging is complex and idiosyncratic: a product of innumerable psychosocial, physical, and environmental contexts that impact upon our brains and bodies over a lifespan (Stein, Schettler, Rohrer, & Valenti, 2008). Even so, most contemporary discourse on improving memory focuses on so-called Alzheimer's disease (AD) (Whitehouse and George, 2008), and the capacity for biological drugs to intercede in its progression, most commonly through the mechanism of removing or pre-empting the formation of amyloid. Unfortunately, despite billions of dollars of investment in anti-amyloid drugs, over twenty candidate compounds have failed in phase III trials in the past decade (Diamond, 2010). Most recently, compounds such as Dimebon, Alzhemed, and Flurizan have failed to live up to the hype (Miller, 2010), while the amyloid vaccine developed by the drug company Elan did not demonstrate capacity to prevent neurodegeneration and improve cognition (Holmes et al., 2008). More recently, the drug semagacestat from Eli Lilly actually worsened cognitive decline in patients who took it, casting further doubts on whether drugs that target amyloid pathways are a viable therapeutic option (Imbibo et al., 2011). Many experts believe that the currently approved symptomatic drugs to treat AD – a condition that increasingly appears to be heterogeneous and intimately related to aging – are not particularly effective in clinical practice and are not helpful in milder memory problems (Whitehouse and George, 2008). Attempts to develop so-called “smart drugs” (some in the form of conventional drugs as well as herbs, vitamins, and nutraceuticals) to enhance cognition in those without symptoms or with mild memory problems have also consistently failed, and may produce unwanted side effects. Despite this fact, consumers continue to infuse these markets with

their dollars in order to get an edge in today's complex and competitive world.

As the pharmaceutical machine slows, a new marketplace of technological “brain fitness” products is emerging to address the fear of brain aging and desire to enhance cognition that are prevalent in modern populations. These products are socio-cultural objects deeply imbued with the values and ideologies of our age, and this article considers their material evolution while also examining limitations in their real-world contribution to cognitive health. Ultimately, a broader and more complex story of “brain health” is advanced, which goes beyond the hype and reductionism of the “brain fitness” commercial marketplace and demonstrates how local communities can play a vibrant role in supporting cognitive and psychosocial wellbeing across the lifespan.

The Brain Fitness Industry: Products, Values, and Ideologies

Broadly speaking, the “brain fitness” technology industry has been estimated to represent a \$300 million marketplace and is projected (perhaps optimistically) to achieve between \$2-8 billion in worldwide revenue by 2015 as the baby boomer generation – to which many products are explicitly marketed – move into their 60s (Fernandez, 2010). Market size estimates vary depending on what types of products are included, and whether one includes professional services or just products for lay persons. Whereas pharmaceutical and “smart drug” markets offer biological products to enhance brain function, this emerging marketplace features legions of digital products including video games and computer software, mobile phone apps, and other products proclaiming to instrumentally maintain or enhance the memory, concentration, visual and spatial skills, verbal recall,

and executive functions of individual users. A neologism forged by the marketplace – “neurobics” – evinces the belief that this new generation of strenuous games, puzzles, and brainteasers can encourage the growth of synapses and dendrites and enhance cognitive health just as aerobic workouts improve pulmonary health and increase cardiovascular health (Ellin, 1999; Kelly, 2006).

Indeed, in exploring the advertising language in this marketplace, one notices the word “neuro” used in protean ways. Most commonly, it serves as a prefix for terms such as “neuro-enhancing” or “neuro-boosting” that focus consumer attention on how products tangibly benefit the function of a single organ – the brain. Concepts such as “neuro-plasticity” (the brain’s capacity to rewire itself throughout life by creating neural connections in response to mental activity) and “cognitive-” or “neural-reserve” (the brain’s built up resilience to age-related pathological changes), give the impression of scientific certainty that products are capable of physically impacting the brain at the molecular level. Frequently, products are said to be “clinically proven” to improve cognitive performance in users of all ages, while other marketing campaigns boast that their products are “designed by neuroscientists” or endorsed by medical professionals (such as the Japanese physician Dr. Ryuta Kawashima, who gives his imprimatur to the bestselling Nintendo’s Brain Age games). Occasionally, more lofty claims will surface, such as the promise that brain fitness technology can affect the brain to the point of preventing, slowing, or reversing dementia.

This iterative marketing language contributes to a certain “fetishization” of the brain that

renders the 3-pound organ in our heads both an object of alterity and veneration. Rather than being understood as one of many vulnerable organs within an intricate biological system, the brain is perceived as a separate, privileged entity that healthy individuals must constantly stimulate, rewire, rebuild, nurture, and attend to if they are to maintain soundness of mind and selfhood. Despite well-established connections between the health of other organs (such as the heart and vascular system) and cognitive wellness, the very concept of “brain fitness” isolates the brain, regarding it as an organ possessing health standards clearly delineated from the rest of one’s body. Indeed, some of the most popular products are designed to explicitly measure how “big” or how “old” one’s brain really is, instantiating standards of productivity for normative mental output that can be met through committed use of the product. Mass marketing slogans such as “Give your brain the workout it needs!” (Nintendo Brain Age), and “Flex your brain the fun way!” (Big Brain Academy) allude to the rather demanding relationship these technological products forge between consumers and their brains. Posit Science, a leading software company, even suggests to potential consumers that, in return for playing brain fitness games, “Your brain will thank you” – a slogan that bifurcates “self” and “brain” while imputing equal agency to both.

In placing a preponderance of focus on improving the brain and its functions, the objects of the brain fitness industry clearly embody Western values of rationality, cognition, memory, and quick thinking, as well as a positivist faith in the ability of science and technology to deliver innovations that contribute to human wellbeing. These products are also informed by principles of liberalism, the political philosophy that attaches paramount

moral value to the individual while valorizing ideals of liberty and freedom. The tenets of liberalism hold that individuals have an intrinsic inclination towards self-sufficiency and separateness, and that protecting this basic truth should be of primary importance rather than larger community needs. Whereas pre-capitalist philosophy emphasized wholeness and completeness of communities, neoliberal political systems flourishing in capitalist countries of the 21st century foster the concept of the atomistic individual within the marketplace who makes himself whole (i.e., the self-made man) (Arblaster, 1984).

Modern brain fitness technology products have been physically shaped by the neoliberal ideologies of the marketplace. While some products may feature and encourage multi-person functionality, many are sold in single units and marketed for individual consumption on personal computers, individual video game consoles, PDA-like devices, or mobile phones. Although some long-term care facilities and other organizations such as hospitals and schools have purchased multiple copies of programs and are beginning to foster interaction through peer collaboration, and some emerging web-based products are designed to encourage social networking, brain fitness products themselves have dictated that brain healthy activities generally occur during private, sedentary moments in the seclusion of one's home rather than in the context of group interaction. As discussed above, the brain is most often treated as a symbiotic source of selfhood for the atomized consumer: an organ that must be constantly maintained and improved through personal action if one is to reap the benefit of continued soundness of mind. The prevailing meaning conveyed by marketing departments is that when one uses products in a disciplined manner, consumers can enhance their neural pathways, thereby perfecting

themselves from the molecular level outwards and slowing or preventing the encroachment of neurodegeneration.

Problems in the Marketplace

At present, the brain fitness technology industry is being met with increasing scientific, if not cultural, scrutiny (Fernandez, 2010). Despite a few modestly positive studies in older adults (Ball et al., 2002; Belleville, Gilbert, Fontaine, Gagnon, Menard, & Gauthier, 2006; Papp, Walsh & Snyder, 2009; Smith et al., 2009; Spector et al., 2003; Klingberg, 2010), empirical support for the efficacy of brain fitness training programs in meaningfully improving cognition is generally insufficient. Relatively few products have been rigorously evaluated using scientific methods or reported in peer reviewed journals, and most existing studies generally evaluate low-intensity interventions in which community-dwelling adults may engage in the intervention for 3 or fewer hours per week. When they have been evaluated, task performance is relatively easy to demonstrate, some cognitive generalizability is sometimes reported, but measuring improvement in daily life has rarely even been attempted. A recent study in *Nature* (Owen et al., 2010) evaluated 11,430 participants in a six-week program, finding no transfer effects from the training tasks of brain fitness games to more general tests of cognition (i.e. reasoning, memory, planning, visuospatial skills, and attention). Other meta-analyses have found no evidence that structured cognitive intervention programs actually delay or slow progression to AD in healthy elderly (Papp, Walsh & Snyder, 2009). Consumers of digital brain fitness games and training programs may marginally improve at the games themselves, but it can fairly be asked whether any real-world value

exists if such benefits are not extended to everyday tasks or quality of life? Moreover, it is reasonable to ask whether we should expect a profound transfer to activities of daily living when most interventions occur across such short time intervals at such low “doses”.

In fact, it is not surprising that a human being who practices performance in *any* task will improve over time. The crucial question, which investigators have explored for several decades, is whether the increments generalize to other domains of thinking and whether they improve activities of daily living (Ball, Wadley, & Edwards, 2002; Detterman & Sternberg, 1982). If one performs a visual recognition task, for instance, will it generalize to auditory recognition or to memory improvements? And even if there is some evidence that past specific activities improved performance and other related but different tasks, how does performance in rarefied lab environments translate into functioning in the context of one’s daily life, which occurs in many diverse environments full of potential confounders? Further, studies must accept the reality that peoples’ self-ratings of their own function are often inaccurate and subject to many influences that may bias the conclusions. Reported self-improvement in studies may reflect a personal justification for having spent as much time working on the particular brain fitness game. Further, it is seldom discussed what should constitute sufficient proof in brain fitness studies. Are pre- and post-comparison of performance all that is needed? Is a well-conducted randomized control trial (RCT) required, or not? And perhaps most importantly, what do we compare in our efficacy studies? What is the equivalent of the placebo in studies that use computer programs or video games? Ultimately, investigation

into the efficacy of brain fitness technology is still relatively young, and adequate supporting data have not yet been published (Fernandez, 2010; Klingberg, 2010). Future research on brain fitness products most certainly merits continued investment – particularly studies that might address the dosing issues by embedding brain fitness activities in regular life activities. However, as long as evidence remains lacking, the industry’s claims represent the hype of marketing departments rather than a genuine hope earned through thorough scientific inquiry.

Another major hurdle for brain fitness technology is that the industry is predicated on the fallacy that consumption of single commercial products can forestall the complex, heterogeneous, multi-factorial processes of brain aging that occur across the life course. This reductionist mentality, which has hitherto driven the development of pharmaceuticals, and “smart drugs”, is now being projected onto a new breed of technological product. However, the consequence of reductionism is that it disregards the myriad factors that influence brain health across the lifespan (e.g. diet, exercise, exposure to neurotoxins, psychosocial stress, learning opportunities, access to healthcare, head injuries, etc) (Whitehouse & George, 2008; Stein, Schettler, Rohrer, & Valenti, 2008). In the world of brain fitness, “neuro”-stimulation is king, and the products one might use to accomplish this task are the sine qua non of cognitive wellbeing. But humans are not merely de-contextualized brains; in fact, brains are embedded amongst many other vital organs in the bodies of individual persons who are interdependent members of families, neighborhoods, local communities, national constituencies, and natural ecosystems. Manifold forces at each of these levels impact neurodegenerative

processes from womb to tomb, with “cognitive health” being the collective property that emerges from the interaction of these inputs across our lives. To ignore the complex etiology of “neurodegeneration”, and thus to fail to frame brain aging as a public health and broader social issue, is a conceit fostered by a neoliberal-capitalist approach to brain fitness.

How We Can Do Better – Brain Health in the Context of Communities

Advancing a broader understanding of brain health requires us to go beyond the dominant reductionism of the current brain fitness commercial marketplace and ask how our most proximate relationships and local communities can play a role in cognitive and psychosocial wellness. After all, once we accept that humans are not merely atomistic brains with normative standards of output, but rather intricate, interconnected beings with psychological, social, emotional, and spiritual dimensions whose brains are impacted by a multitude of insults over the course of our lives, it follows that our “brain health” activities should mirror the complexity of our nature rather than be dictated by the reductionism of the marketplace (Whitehouse, 2010). One wonders, for instance, whether the scarce time and money resources spent on commercial brain fitness technology might be better invested in more dynamic activities, such as going on a walk in a park with friends, visiting a museum, volunteering in one’s community, taking an adult education class, and so on. Such activities are sufficiently “neurobic” (and potentially aerobic), but also enable one to establish meaningful relationships within the protective social networks of local communities while both enjoying and adding something of value in their neighborhoods.

Of course, measuring the effects of these complex activities is much more difficult than the classic method of swallowing a pill and comparing it to a similar-looking inactive product (i.e. placebo). Testing a brain fitness video game or computer program is also much easier than testing a complex social intervention, and intellectual property can be more easily assigned per pill or software program than a project undertaken in a shared community space. Hence, RCTs are aptly referred to as the “gold standard”, since only those with “gold” and with the promise of making more gold through commercial interests can afford to carry them out. Consequently, pharmaceutical companies can carry out multiple studies and choose to publish and promote only those that demonstrate that their product is valuable. In an era that overvalues certain forms of evidence such as RCTs, a lack of evidence for dynamic community-based activities such as those mentioned above is often interpreted as lack of efficacy.

Despite the challenges associated with evaluating these community-based interventions, when one considers the extant data (Buettner, 2009; Poulain et al., 2004) on longevity and wellbeing, those societies that produce the most centenarians feature some combination of the following attributes: strong families and community affiliations; an overriding sense of purpose, engagement, and contribution in the population; structures to manage and relieve stress; accessible and walkable living areas; low incidence of smoking; opportunities for daily ambulation and natural movement (e.g. walking, gardening, play); humane treatment of the elderly; low meat, plant-based diet with legumes, etc. It is not clear where brain fitness technology might fit on this list, if

assessed. However, these findings would suggest that, despite the neoliberal emphasis on self-improvement through individual consumption – a message that pervades modern capitalist cultures and drives the brain fitness industry – cognitive wellbeing must increasingly be viewed as a public health or even a “local community” issue. It is, of course, unfair to imply that self-improvement activities are intrinsically bad; however, there is value in considering how such activities might be balanced and integrated with more social collaborative approaches.

Making Brain Health Intergenerational

In Cleveland, we have played a role in founding and leading and developing The Intergenerational School, which is the first known school to embrace adults – including persons with dementia – as co-learners with children. For decades, a widening evidence base of cross-sectional and retrospective research has demonstrated that older adults who volunteer in their communities may experience a range of biopsychosocial benefits from physical, mental, and emotional health to longevity (Herzog, & House, 1999; Moen, Dempster-McClain, & Williams, 1992; Musick, Oman, Thoresen, & McMahon, 1999; Post, 2007; Post & Neimark, 2007; Van Willigen, 2000). A subset of research has established that older adults who form relationships with children through intergenerational programs seem to experience specific benefits, such as improvements in health status and wellbeing (de Souza, 2003), increased activity, strength, and cognitive ability (Fried et al., 2004), the creation of meaningful relationships (Gigliotti, Morris, Smock, Jarrott & Graham, 2005), enhanced self-esteem (Jarrott & Bruno, 2007), increased social capital (de Souza & Grundy, 2007), and better psychological functioning

(Chung, 2009). Our own experimental research at the school has shown that intergenerational volunteering reduces stress for persons with mild to moderate dementia (George & Whitehouse, 2010; George and Singer, 2011). Such data demonstrate the potential of local communities to intervene in the many pathways of cognitive aging, particularly for vulnerable older persons in our culture (Whitehouse & George, 2008).

Brain fitness technology can certainly play a role in community-based activities. Indeed, on the floor below the school, which is housed in a community center for aging, there once existed a computer lab stocked with brain fitness technology that was frequented by elders from the surrounding community, including persons from local assisted living homes. Several years ago, after noticing older individuals sitting alone playing brain fitness software in front of personal computers, we made an arrangement to pair our students with elders in the lab once each week. What became important over the course of this partnership was not merely the brain fitness technology but the *relationships* that formed around that technology: the intergenerational transmission of knowledge that occurred – the mentorship, reciprocity, and meaningful social interaction that took root in the context of this shared community space. Brain fitness products were not an end in and of themselves, but were a means of facilitating cognitively and emotionally complex interactions in a shared space in ways that were mutually enriching for the older and younger participants (although it could well be argued that objects such as books do this just as well, and at much less cost). Students at the school have also been involved in co-facilitating workshops with elders 55-years and older who were seeking to enter or re-enter the workforce, but who lacked basic computer skills. During these workshops,

students sat between and amongst their elders in the computer lab, teaching older partners how to search the Internet, craft a resume, create basic word processing documents and PowerPoint presentations while in turn learning important lessons from elders about the job-search process and the skills required to be employable. In each scenario, the intergenerational relationship forged around the technology produced an emergent dynamic that would not have been possible if the technology had been consumed in private.

Future research at the school will use mixed methods to explore whether the intergenerational usage of online technology such as the 3-D world of Second Life and Microsoft's Xbox Kinect technology can foster a more social, digital environment in which participants construct rich moments of intergenerational engagement and enable a flourishing of relationships in both shared and virtual spaces. This kind of technology can promote different ways of engaging through the generations (e.g. through avatars) and the computer (e.g. through body movements individually or in multiage groups). The learning fostered by using computers and online networks to understand systems thinking about issues such as human relationships to and responsibilities for watersheds can enhance individual and community thinking about the future. These sorts of dynamic activities can take brain health to deeper and broader levels than the current marketplace allows (Whitehouse, 2010).

Conclusion

Ultimately, brain fitness technology has a role to play in the complex project of cognitive

wellbeing, and may make even more profound contributions to acute recovery from such conditions as stroke and traumatic brain injury. However, their current limitations – not to mention the excesses of the marketing departments currently promoting the products worldwide, especially to baby boomers – must be deeply scrutinized and matched by a counter-narrative that reinforces broader, multi-factorial notions of brain health and the interdependency of human populations, and pushes us to think more imaginatively about cognitive health in the context of communities. Framing brain health as a community/public health, ethical, and social issue can countervail against the current reductionism of the neoliberal “brain fitness” marketplace while encouraging greater reflection on what it means to protect brains that exist over time in shared social and natural environments that can exert deleterious, neutral, and ameliorative effects on human cognition. We have no doubt that learning technologies have a significant potential role to play in improving our thinking and valuing of each other and of nature that likely far exceeds the capacity of biological products. We do hope, however, that the promise of these technologies is not weakened by the excessive expectations created for the rather limited contemporary approaches to brain fitness. As we have demonstrated at The Intergenerational School, the most powerful “brain health” activities can have the double benefit of enriching one’s local community and creating life-affirming relationships at the same time as they aim at the improvement of one’s brain at the molecular level.

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