

11-2011

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## Recommended Citation

Holding, Lynn. "Digital Natives and Digital Immigrants: Teaching and Learning in the Digital Age." *Mindful Voice. Journal of Singing* 68, no. 2 (2011): 199-206.

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# Digital Natives and Digital Immigrants: Teaching and Learning in the Digital Age



Lynn Holding

**T**HE PREVIOUS INSTALLMENT OF “Mindful Voice,” “Creativity in Crisis?,” concluded with a look at some of the cognitive effects of digital technology, and what that technology’s overuse may be wreaking upon human creativity. As I noted in that column,

... creativity . . . does need mental space. And space implies time. The experts are still debating whether or not digital technology destroys concentration, but no one who uses it can dispute the fact that it gobbles up big chunks of our time.<sup>1</sup>

According to technology reporter Matt Richtel, in one recent year (2008), the average person consumed *three times* as much information each day as he/she did in 1960.<sup>2</sup> This is almost entirely due to the limitless amount of information that is now so easily available via the Internet on personal computers and Smartphones. The question is, what is this information overload doing to our brains? That is exactly the question that author Nicholas Carr set out to investigate in his book, *The Shallows: What the Internet is Doing to our Brains*. Implicit in Carr’s title is one of his central conclusions: when information exceeds the brain’s “cognitive load” (the limit of our short-term memory), we lose our ability to think deeply and draw connections between new information and things we already know. Instead of diving deep, we “zip along the surface like guy[s] on Jet Ski[s].”<sup>3</sup> In other words, the way we read on the web has not just changed the way we read; it has changed the way we think.

“The technology is rewiring our brains,” said Nora Volker, director of the National Institute of Drug Abuse and one of the world’s leading brain scientists. She and other researchers compare the lure of digital stimulation less to that of drugs and alcohol than to food and sex, which are essential but counterproductive in excess.<sup>4</sup>

This and future installments of “Mindful Voice” are a closer examination of cognitive function in the Digital Age, both for so-called “Digital Natives” (those who were born into the Digital Age) and “Digital Immigrants” (those who have migrated to the Digital Age).

If you are neither native nor immigrant, life without digital media is still a viable choice, though probably not for long; as we shall see, there is growing concern among experts that technology has the potential to be addictive, and the new wave of self-help books on the market advise “unplugging” as the first line of defense. However, to choose this path is to miss out on the wonders of digital media, which has the potential to enrich as well as entrap. Teachers who maintain a personal aversion to technology should not take a

pass on this subject due to their personal views. This column is predicated upon the maxim that a shift in emphasis must occur in light of the Cognitive Revolution, from how well teachers teach, to how well students learn; therefore, understanding the cognitive implications of technology is essential for teaching the new tribe of digital natives. And when it comes to the Digital Revolution, all perspectives are needed because we are, in the words of Sherry Turkle, psychologist and director of the Massachusetts Institute of Technology's Initiative on Technology and Self, still in "the early days."

Because we grew up with the Net, we assume that the Net is grown up. We tend to see what we have now as the technology in its maturity. This is a dangerous habit of thought. We need to remember that we are in very early days.<sup>5</sup>

### **DIGITAL HEAVEN: TAKING THE MEASURE**

The previous two decades have ushered in an onslaught of new technology, and when compared with other significant innovations that deeply changed human culture (the printing press, the clock, the microscope, the automobile), the magnitude of the effect of the digital revolution is unprecedented in human history. On the upside, human endeavors as disparate as medicine, marketing, and music all have been enhanced by the ability of their practitioners to harness the riches of digital media.

For musicians, the once cumbersome and expensive aspects of self-management have been utterly transformed by digital media. Tasks like producing recordings, printing letterhead and business cards, distributing publicity photos, and networking with other professionals all can be accomplished in record time, with polished results on the slimmest of budgets. For the international musician, Smartphone applications provide instant access to online dictionaries, translations, currency converters, and GPS navigation systems. On any continent, we can stay connected with agents, colleagues, and coaches round-the-clock if we wish, and indeed, such connection is now practically expected.

For students and teachers of singing, recording lessons is not only simpler than in the old cassette and VHS tape days, but now, like photos, these data files can be posted, shared, and swapped. For the independent studio teacher, the benefits experienced through the use of new technology are many, translating as they do into increases of those two most basic of resources, time and money.

But just as the white hot intensity of passion cannot burn forever, our collective love affair with technology is being tempered (if not always cooled) by our personal experiences with what Matt Richtel has dubbed "the screen invasion."<sup>6</sup>

As performing artists, we must consider the introduction of digital media into the once sacred space of the concert hall. While new technology opens many new vistas for creative exploration, we must also face what technology's affiliated byproduct, the fragmentation of audience attention spans, portends for the future of live performances. For teachers, new research linking attention to the interrelated tasks of memory, learning, and recall is worth reconsidering in light of early warnings from the digital front.

While there are as many different opinions on technology's merits and pitfalls as there are entities that have come to depend upon it, there is broad agreement on one key point: the technological revolution (interestingly, often described in catastrophic meteorological terms like "hurricane," "flood," and "tsunami") is over. Although some might yearn for a return to a former, less digitally interconnected era, this desire is simply not realistic; we live in a digital age and technology is here to stay. However, just because the floodwaters of revolution have subsided, we need not be complacent about what has washed up on our collective shores. We are now, as Sherry Turkle advises, "well past the time to take the measure of what the costs are."<sup>7</sup>

### **TROUBLE IN PARADISE: THE SCREEN INVASION**

Scientists have begun to sound an alarm concerning no less than the observable evolution of the human brain, thus countering ecstatic reports from the digital front with darker projections about the shattering of human attention spans. Dr. Gary Small, one of the first neuroscientists to study the effects of digital media on the brain, is still one of the few to do so. His early research involved taking MRI scans of people's brains while conducting two different activities, reading a book and conducting an Internet search.

This summarizes what we found in that brain on our Google study. So here's your brain reading a book, [and] here's your brain on Google; more than a two-fold increase in the extent of activity. And notice how much activity there is in the front

part of the brain, the decision-making part of the brain, which makes sense because we know we're making lots of decisions when we're searching on line . . . [but] on a brain scan, big is not necessarily better.

. . . if you go to the gym and you start lifting weights, at first, you're going to have to use a lot of energy. But if you train, you're going to become much better. You're going to be in better shape, you're going to lift more weight, and it's not going to take that much energy. So one could argue that small is better. It's a little bit like playing golf; you want your score to go down.<sup>8</sup>

Concerned educators and parents have begun to notice, with a creeping sense of unease, that the digital natives in their care exhibit obsessive tendencies when it comes to their gadgets, be it through an inability to maintain focused concentration on one task, or the senses of disorientation and anguish that accompany the removal of a keyboard from beneath their fingertips. Therapist Gary Greenberg related the following story of what happened when he tried to persuade a teen client to relinquish her gadget.

[B]efore she could sit down, I asked Kate to hand me her phone. Her parents, already seated, froze as she swung her head around and trained her eyes on me. It was, I realized, the first time we'd made eye contact, and what I saw was a mixture of fear and anger not unlike that of a raccoon cornered in a vegetable patch by an irate gardener wielding a shovel.

"Why?" she demanded. "Because I have a really hard time concentrating when you're distracted," I said. "I keep wondering what's going on your phone, and I figure that whatever it is must be more interesting than what's going on in here."

"Well, that's for sure."

"I'm certain that's true," I said. "Nothing here can compete with what's on your phone. But sometimes we have to pay attention to less interesting things." I reached out my hand, and she put the phone in it. It was warm and moist. I thought I could feel the indentation of her fingers on its rounded edges. "It seems almost like this phone is part of you," I said as I put it on my desk. "Like another limb or something."

"No duh," she said. "It is." She held my eyes. There was no shame or defensiveness in them now, let alone fear. Just contempt.

It wasn't the first time a kid had made me out to be a fossil . . . But the gap between Kate and me wasn't cultural or political in origin. It had to do with different ideas about what kind of creatures we are. My comment, which I'd made for no particular reason, hadn't told her anything she didn't already know—that she was in some fundamental way different from me, and from the rest of the grown-ups with whom she had to share the planet. We had only four limbs. She had five, and with that extra

appendage she could reach out of her tiny, bounded self and into the whole wide world—or at least the world that could blink to life on her screen.<sup>9</sup>

But these tendencies are not just the province of young people; they also occur among their parents and educators, who at present are largely digital immigrants. Who says you can't teach an old dog new tricks? Even that old saw has been overturned through the doctrine of "neural plasticity," which is, one might say, a double-edged saw. For as we shall see in the upcoming section on neural plasticity, although new tricks can be learned, they cannot be guaranteed to be good ones.

In the workplace, the twin spectres of interruption and stress currently haunting the modern office environment have spawned a specialty niche in personnel circles. Attention Management and Interruption Science are now *bona fide* subjects, and are hot topics in business news and on the lecture circuit. According to Gloria Mark, a leading researcher in these new fields, the average "knowledge worker" (those who manage information, like librarians, teachers, lawyers, and physicians) switches tasks every three minutes, and, once distracted, takes nearly a half-hour to reconnect to the first task.<sup>10</sup>

Terms like "learned attention deficit disorder" and "attention deficit trait" have been introduced by experts who posit that heavy technology use is actually *creating* ADD/ADHD in people not otherwise disposed toward the disorder (thanks to neural plasticity),<sup>11</sup> and attribute much job-related stress among knowledge workers to online navigation within what one tech blogger has called "an ecosystem of interruption technologies."<sup>12</sup>

There is a growing cohort of psychologists who note the potential for outright addiction to the Internet and other digital media, due to our twin systems of "seeking" and the dopamine rush that rewards it.<sup>13</sup> Experts and nonexperts alike have observed that a harm borne of personal digital overuse, "inattention," is besetting personal and family relationships and retarding critical socialization in teens and young adults. Dr. Clifford Nass, a communications professor and cognitive researcher at Stanford University, worries that inattention interferes with the development of empathy, the ability to feel another's emotions.<sup>14</sup> Empathy is so central to the human condition that it is one of the basic components that sets us apart from other mammals. Lack of it is linked to a sup-

pression of the brain's "mirror neuron system" (MNS) and a host of behavioral disorders, ranging from Asperger's Syndrome to psycho- and sociopathologies.

Pundits have suggested that the same kind of ambitious public health campaign that went after pollution and smoking as major risks to human health will have to be applied to society's addiction to its gadgets in order to bring about a "renaissance of attention,"<sup>16</sup> but this will be effective only if society recognizes that it has a problem. Dr. Small had this to say when asked about the potential for addiction to digital media:

I think [digital media] is addictive. There's controversy among experts whether it is or not. In Asia, there's a recognition that teenagers, many teenagers, are addicted to video games. I think we're behind the Asians in terms of focusing on the problem.

. . . We're immersed in it. And it's changing so rapidly, we're just beginning to grasp what's happening. So, think of how long it took us to understand that smoking was bad for our health. I think it takes people a while for reality to hit them in the face. It's hard to get people to stop texting while they're driving, although it's a twenty-three times greater risk of having an accident. How do you get people to stop these behaviors? It's very difficult.<sup>17</sup>

### WHO IS MINDING THE STORE?

Enthusiastic technology geeks note that there is, at present, little research that demonstrably proves the negative effects of technology on our brains; but an absence of evidence does not equal proof positive that there is none to be found. The truth is that very little research has been conducted, period—which raises the question: Why isn't anyone studying the effects of the screen invasion on our brains? One answer lies in the rapid growth of technology itself, which makes the subject matter a moving target, impossible to pin down. Researchers who attempt to study it face a Sisyphean task.

By the time you design a research study, apply for funding, implement the study, and you publish the results about the technology, what has happened? The technology's obsolete. We moved beyond it. And so the technology and the practices that go with the new technologies, they keep outdistancing the research. The research can't catch up with it.<sup>18</sup>

A second, but perhaps more fundamental consideration is funding, which introduces a vexing question: In whose interest would it be to fund research on the cognitive effects of digital technology? Surely not the video-game industry that, according to industry statistics, has

grown from a seven billion dollar industry in 2005 to well over 25 billion dollars in 2010,<sup>19</sup> in stark comparison to the U.S. digital music market, which grew to only 3.2 billion in 2010.<sup>20</sup> Leaving aside the gnarly philosophical questions of classical music as entertainment or art, and whether or not art is, or should be, "entertainment," this statistic is a sobering one for musicians.

Social media sites like Facebook and Twitter are sustained by users who generate content by freely chatting, posting, blogging, and tweeting. So they would stand to lose mightily if subscribers were to heed any research that might suggest humans curb their online interactions in favor of live, face-to-face encounters.<sup>21</sup>

When 85% of adult Americans own cellphones, and some 75% of American teens do, the wireless industry has everything to gain by keeping people connected. American teens oblige, for while their ownership statistics may ride slightly under that of their parents, their use far outdistances them. A recent study showed that an average American teenager sends or receives 3,339 text messages a month. Leading the pack are *über*-connected teen females, who send and receive an average of 4,050 "texts" per month—which breaks down to 135 text messages per day, or more than nine each hour they are awake.<sup>22</sup> With the advent of Smartphones, these numbers are all expected to rise.

So the absence of negative evidence concerning the effects of digital technology on humans does not prove its worth; rather, it suggests that too few researchers are asking critical questions. And given the lucrative rewards that are risked by funding illuminating research, a final question concerning scientific research arises: Who is minding the store?

### GAME-CHANGE

Inundated as we are in what Turkle calls "these techno-enthusiastic times," it is challenging to find research on the cognitive effects of digital media. But in response to this dearth of information, Turkle points out that

. . . saying that we know too little to make a judgment about technology has, as its starting point, that we know nothing about human development, or that somehow the game has completely changed now that we have a technology to put in its place.<sup>23</sup>

As Turkle implied, we collectively know plenty about human development to make, at the very least, reasoned

guesses about the negative effects of technology, and equally astute observations about how we think, behave, and interact when we are not overly preoccupied with it. (For those who are intrigued by the prospect of an “opt-out challenge,” see the *New York Times* discussion on going “unplugged.”)<sup>24</sup>

As to Turkle’s second point—has “the game” of human development changed because of the screen invasion? Many experts in the brain and behavioral sciences believe it has. In the field of neuroscience, when the word “change” is applied to the brain, the subject is “neural plasticity.”

### NEURAL PLASTICITY

For much of the past several centuries, it was believed that the adult brain did not change much past childhood and was, by all accounts, rather fixed. But thanks to several intrepid neuroscientists who, despite ridicule and suppression by the gatekeepers of their profession, plowed ahead with their research, it is now accepted wisdom that brain cells (*neurons*) can regenerate (*neurogenesis*) and that the brain changes continually in response to experience (*neuroplasticity*). Still, it could take decades to overturn what psychiatrist Norman Doidge calls “a neurological nihilism” that took root in popular culture, engendering a hopeless response to many brain disorders, and poisoned our collective belief in the possibility for change.<sup>25</sup> Indeed, the tenacity of this outdated view is revealed when people still speak of abilities as “hard-wired,” or refuse to apply themselves to a task on the grounds that they “lack the talent.”

The occasion of New Year resolutions for 2011 elicited a plea from renowned neuroscientist Oliver Sacks entitled, “This Year, Change Your Mind.” Sacks allowed that most people still “do not realize that they can strengthen their brains,” and exhorted his readership to think again in light of the doctrine of neuroplasticity.

Whether it is by learning a new language, traveling to a new place, developing a passion for beekeeping or simply thinking about an old problem in a new way, all of us can find ways to stimulate our brains to grow, in the coming year and those to follow. Just as physical activity is essential to maintaining a healthy body, challenging one’s brain, keeping it active, engaged, flexible and playful, is not only fun. It is essential to cognitive fitness.<sup>26</sup>

Indeed, just as a bicep is enlarged or a waist whittled by sessions at the gym, the brain actually changes its

structure in response to how it is used, and (except in cases of dementia or other forms of brain disease) it does this continually, retaining a measure of this ability well into old age.

The process of this continual reshaping of the human brain is quite complex;<sup>27</sup> simply explained, any task or sensation, whether mental or muscular, creates a response in the spaces (*synapses*) between our brain cells. If the task is repeated often enough, the repetitions eventually create synaptic links in a “neural pathway.” This process was neatly summed up in the catch phrase known as Hebb’s Rule: “Neurons that fire together, wire together.” Repeated firing of the same neurons in the same pathway is what creates memory; and memory is so fundamental to learning that, in a layman’s understanding of it, one could say that memory *is* learning.

[T]he ability to learn starts with the ability to remember. An organism can learn from experience only if it can rewire its nervous system in a lasting way; there can be no learning without memory.<sup>28</sup>

But neural pathways aren’t always constructed; they can also disintegrate, either by deliberately stopping or changing thoughts (a technique used in anger management therapy, for example), or by disuse through inactivity, injury, or disease. Hence an aphorism popular in many rehabilitative therapies, including those for stroke and dementia, has taken on new urgency due to current research in neural plasticity: “Use it or lose it.”

Singers who have studied languages other than their own can especially appreciate this observation. When preparing an opera role or recital literature in a foreign language, or while living in the country in which that language is spoken, the rate at which the language is learned accelerates dramatically. Unfortunately, when the curtain falls for the last time, if that same level of practice is not maintained, most people find that their newly acquired foreign language abilities quickly atrophy.

For all musicians, these descriptions of neural pathways, learning, and memory describe exactly how, neurologically speaking, musicians acquire new skill through repeated practice. “Practice makes perfect,” or at least it aims us in that direction. What musicians have known for centuries is corroborated by research in the field of

“motor” (muscle) learning theory, namely, that practice itself is the most important variable in motor learning.

### THE PLASTIC PARADOX: ROADBLOCKS

But what about that “double-edged saw” I mentioned? New neural pathways can be startlingly quick to emerge, but once constructed, become more habitual with use, and thus harder from which to break free. Doidge has dubbed this rigidity the “Plastic Paradox.” Is change from even rigid habit possible? Apparently, yes; it is merely difficult. And in the case of sensory processing (also known as motor or “procedural” learning), in order to create a new neural pathway, a so-called “roadblock” is needed to effectively steer us away from the entrenched one. Studies often cited to illustrate this point show that when people are blindfolded to simulate blindness, the cortical areas of the brain formerly devoted to sight quickly diminish while their senses of touch and space become hypersensitive.<sup>30</sup>

A growing body of research in this area suggests that current theories of brain localization (wherein one area of the brain is devoted to one single purpose) is overly simplistic; it appears that when a roadblock is encountered, just as motorists will use their resources to discover out an alternate route, our brains can do the same thing by means of “operators” that process larger fields of more general, sensory information.<sup>31</sup>

Doidge suggests that people wishing to learn a new skill can “vastly increase their processing power, provided they can create a roadblock between the operator they need and its usual function.”<sup>32</sup> An exact roadblock prescription for musicians, athletes, dancers, and others who depend upon a high level of motor skill has not been developed; however, many such people already instinctively create these roadblocks, in order to heighten other senses. Roadblocking is what a musician does when she closes her eyes in order to hear more acutely, or a singer when he wishes to sense his physical responses with more awareness. One could add that skilled teaching includes diverting singers’ attention away from ingrained habits in order to develop new ones; now we can call this “roadblocking” (if we wish), and console a flabbergasted student that we are simply helping him to increase his “processing power.”

### THE PLASTIC PARADOX AND DIGITAL TECHNOLOGY

As we have seen, an emphasis on teaching the motor skill of singing assumes the positive side of neural plasticity, but an emphasis on the acquisition of motor skill necessarily flips the vantage point from teacher to learner. Once that is done, the downside of that same plasticity, the Plastic Paradox, must be taken into account. We have just seen that diversionary tactics, whether self- or externally administered, partially address this paradox. But if we heed the early warning signs from cognitive research, we who teach and learn in the Digital Age face stiff resistance when we attempt to roadblock digital habits, either in ourselves or in our students. In any case, roadblocking is only an effective practice tool, not a viable method of concentration in live performance.

Singing, whether in practice or in live performance, requires sustained focus and concentration. But due to the temptations of digital media, this fundamental requirement is under attack like never before. Singing teachers belong to the category of “knowledge workers” just as surely as the other professions cited earlier, and thus are just as susceptible to “interruption technologies.” If so, we may check up to forty websites a day, or switch Internet programs as much as thirty-six times an hour.<sup>33</sup> There is no question that the Internet affords instant answers to legitimate questions on an almost limitless range of topics. Google translation offers a useable facsimile in the time it takes to type in the original. Sites like YouTube afford instant comparisons between three or more singers performing the same Schubert lied, and since these recordings are not limited to audio, afford an education in itself via the ability to watch how singers handle the physical aspects of performance, from bowing to hand gestures to breathing.

Still, this much task switching, and the resultant attempts to return to task, creates a stress response that isn’t good for us. Stress releases steroid hormones in the body called “glucocorticoids,” which, among other evils visited upon our vital organs, have recently been linked to the death of brain cells.<sup>34</sup> Since practicing any instrument takes focus and diligence, the introduction of digital media into the practice room is likely to produce a similar chain of interruption, task switching, and stress response. If our constant need to be connected becomes a truly addic-

tive cycle, it seems beyond question that it will interfere with all our relationships, including our relationship to our own voice.

Finally, the doctrine of neural plasticity teaches us that the construction of new neural pathways in the brain is not only possible, but surprisingly rapid and powerfully effective. But the Plastic Paradox shows that we become what we practice, even if what we are practicing is what former software executive Linda Stone calls “continuous partial attention.”<sup>35</sup>

Several articles in this column have been devoted to motor learning theory.<sup>36</sup> The questions explored in those articles (Is more practice better practice? What about quality and type of practice? What happens cognitively in between practice sessions?) are valuable for the simple reason that students spend the vast majority of their singing time on their own, away from their teachers. But as research from the cognitive and neurosciences continues to unfold, such questions should be raised perennially, and in light of the rapid evolution of technology, the questions themselves should evolve: Are there different kinds of attention? Are there different attention needs for purely mental versus motor tasks—or does music require attention to both? Is the practice room the scene of focused concentration—or is it just one more space that can be invaded by the ubiquitous range of a Smartphone?

In order to consider these questions, a close examination of attention itself, and its related issue, multi-tasking, will be the subjects of the next installments of “Mindful Voice.” Meanwhile, let us continue to use technology for its benefits and enjoy its wonders, while considering this admonition from Sherry Turkle.

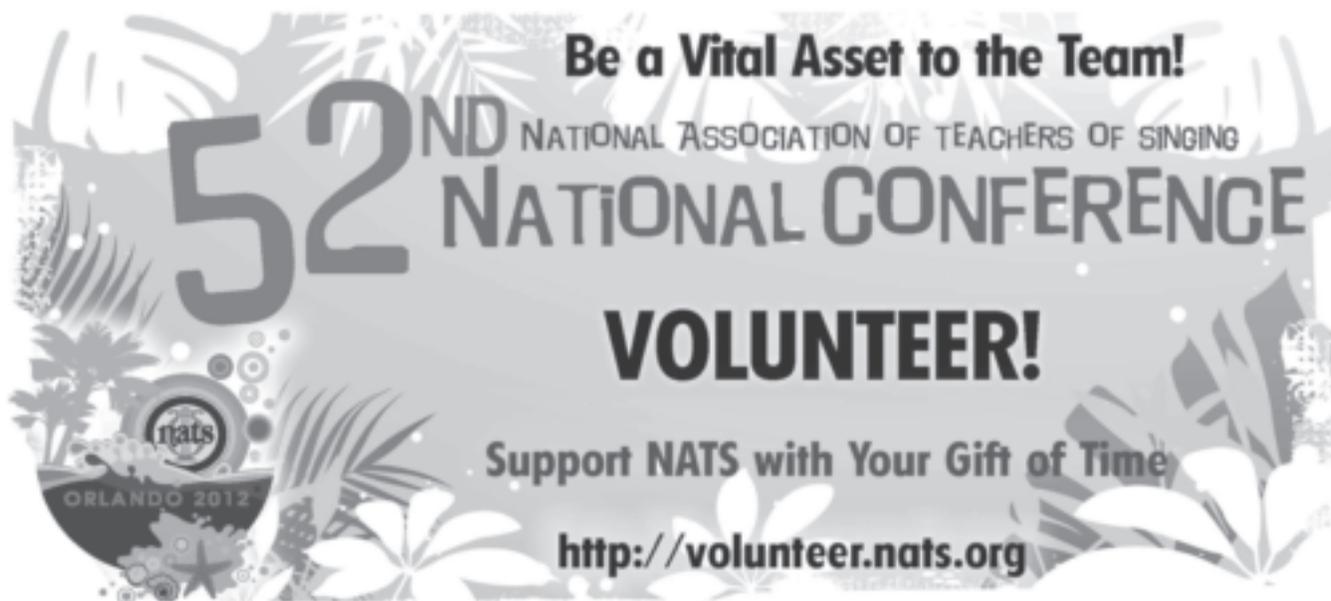
Technology challenges us to assert our human values, which means that, first of all, we have to figure out what they are. That’s not so easy. Technology isn’t good or bad, it’s powerful and it’s complicated. Take advantage of what it can do. Learn what it can do. But also ask, “What is it doing to us?” We’re going to slowly, slowly find our balance, but I think it’s going to take time.<sup>37</sup>

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  32. *Ibid.*, 212.
  33. Richtel, "Digital Overload."
  34. Jonah Lehrer, "The Reinvention of the Self," SEEDMAGAZINE.COM (March 3, 2011): 2; [seedmagazine.com/content/print/the\\_reinvention\\_of\\_the\\_self/](http://seedmagazine.com/content/print/the_reinvention_of_the_self/) (accessed March 3, 2011).
  35. Thompson.
  36. Lynn Holding, "Connecting Voice Science to Vocal Art: Motor Learning Theory," *Journal of Singing* 64, no. 4 (March/April 2008): 417–428; Christine Bergan, "Motor Learning Principles and Voice Pedagogy: Theory and Practice," *Journal of Singing* 66, no. 4 (March/April 2010): 457–468.
  37. Turkle.



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