

# **Has “Growing Up Digital” and Extensive Video Game Playing Affected Younger Military Personnel’s Skill Sets?**

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## **ABSTRACT**

The statistics on today’s youngsters’ involvement with digital technology are staggering – over 10,000 hours playing videogames, over 200,000 emails and instant messages sent and received; over 10,000 hours talking on digital cell phones; over 20,000 hours watching TV (a high percentage fast speed MTV), over 500,000 commercials seen—all before they turn 21. Although these numbers clearly do not apply to every individual, it is a good bet that a great many people with experiences at or above these averages have joined, and will continue to join the military, both as officers and enlisted personnel.

What effect have their “digital” experiences had on them, if any? Has the exposure and practice altered, enhanced, or detracted from any skills or abilities that are relevant in a military context? Surprisingly, there is little existing research to answer this. This paper discusses the current state of research and speculation in this area, and proposes a set of experiments (to be carried out at the United States Naval Academy and elsewhere in the military) which will, over the coming year, attempt to answer these question more definitively.

## **ABOUT THE AUTHOR**

Marc Prensky is an internationally acclaimed speaker, writer, consultant, futurist, designer and inventor in the critical areas of education and learning. Marc is the founder and CEO of Games2train, an e-learning company whose clients include IBM, Bank of America, Pfizer and Nokia, and the founder of The Digital Multiplier, a group dedicated to eliminating the digital divide worldwide. He is the author of the critically acclaimed book *Digital Game-Based Learning* (McGraw-Hill, 2001). Marc has created over 50 software games, including the world’s first fast-action videogame based training tools and world-wide, multi-player, multi-team on-line competitions. Marc has been featured in articles in *The New York Times* and *The Wall Street Journal*, has appeared on CNN, MSNBC and PBS, and was named as one of training’s top 10 “visionaries” by *Training* magazine. He holds an BA from Oberlin and graduate degrees from Middlebury and Yale and an MBA with distinction from Harvard.

# Has “Growing Up Digital” and Extensive Video Game Playing Affected Younger Military Personnel’s Skill Sets?

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## BACKGROUND - THE DIGITAL NATIVES

Our young people today are being socialized in a way that is vastly different from their parents. The numbers are overwhelming: over 10,000 hours playing videogames, over 200,000 emails and instant messages sent and received; over 10,000 hours talking on digital cell phones; over 20,000 hours watching TV (a high percentage fast speed MTV), over 500,000 commercials seen—all before the age of 21. <sup>1</sup> And, maybe, *at the very most*, 5,000 hours of book reading. <sup>2</sup> These are today’s “Digital Natives.” <sup>3</sup> A great many of them are also today’s – and will certainly be tomorrow’s – war fighters.

How have these “digital” experiences – clearly never before experienced in the history of mankind – affected the people who went through them? Has the process changed them in any significant and important ways? From a military perspective, has it changed them in any ways which affect their capabilities to perform the tasks required by today’s and tomorrow’s military, be those tasks war fighting, peacekeeping, or anything else?

Moreover, we might also ask “Have these experiences in any way affected the ways these people relate to each other?” And what are the implication of this, if any, for leadership and chain of command?

These are important questions for the military to begin asking now, so that data can be collected, hypotheses tested, and conclusions drawn – conclusions that are likely to affect how the military trains and operates in the digital age. We all know that digital age *technology* is different, but what about the digital age *people*?

An additional important consideration here is that it is not just the people on *our* side who are “growing up digital” – our potential opponents are as well. The greatest fear of many observers today is asymmetric information warfare, where

a small number of enemies with appropriate technology skills penetrate our systems and bring them to a standstill. We would certainly like to understand the minds of these potential opponents. Are they the same as the enemies of previous generations? Or has growing up with digital technology affected the ways *they* think as well?

None of these questions have good answers at the present time. This is because very little research has been done on the differences that “growing up digital” <sup>4</sup> has produced in the ways the people who experienced it think and act.

Yet there are many hypotheses. Many observers, including a number of prominent scientists, psychologists, neurologists, (not to mention parents, teachers, and officers), as well as myself, have found these so-called “Digital Natives” to be different in many ways from their predecessors. <sup>5</sup> Proposed differences include, among others, the ability to process information more quickly, to multi-task and parallel process more easily, to better perform certain visual tasks, and to communicate in new and different ways. Some observers suggest we should distinguish between the effects of “passive” experiences such as watching television, and the “interactive” experiences of web searching, problem solving and playing video games.

Certainly many of the Digital Natives’ outward behaviors are different – their ubiquitous use of instant messaging and cell phones to communicate, for example, and the enormous amounts of time many of them devote to digital pastimes such as video games, blogging and other web-related activities.

The important question, however, is “Have their skill sets actually changed as a result of this?” I.e. can they do things their predecessors couldn’t as a result of their digital upbringing and environment?

We might even go further and ask “Has their thinking changed?”, particularly in ways that could affect their abilities to perform military tasks, from fighting on the front lines to leading and commanding forces.

These are not easy questions to answer.

To do so, we must devise clever experiments that allow us to separate out the effects of the subjects’ digital (or non-digital) upbringing from the effects of age, sex, intelligence, experience or other factors. We must listen to what subjects have to say about themselves and others. We must compare subjects of the same cohort who have had certain experiences with those who have not. And we must even try to compare subjects of similar backgrounds from different cohorts, although this can be problematic, especially without baseline data.

In the end military planners will need to come to conclusions and agreement as to whether the effects of the digital experiences of today’s and future military generations warrant making changes in our military systems, doctrine and/or behaviors.

Some of these changes, of course, have happened already. Michael Parmentier, former director of the OSD’s Office of Readiness and Training has stated that it is clear that 18-year-olds expect to be hooked up electronically to the world “because that is the way they do things. If we don’t do things their way they’re not going to want to be in our environment.”<sup>6</sup> E-mail has already become the main communication link between troops on deployment and their families. Military blogs often brought us a different picture of Operation Iraqi Freedom than the “official” one. The web site [www.dodgamecommunity.com](http://www.dodgamecommunity.com) documents over 50 games, both custom and commercial-off-the-shelf, that are currently being used today to train recruits and officers. Many of these games cannot be played by – or require a much steeper learning curve from – military personnel brought up in the non-digital world.

What *about* those military personnel brought up in the non-digital world? I often refer to the people from the generations who came to digital technology later in life as “Digital Immigrants.”<sup>7</sup> This turns out to be a very useful metaphor because – to the Natives – these people, despite all their skill and best intentions, typically retain

a digital immigrant “accent.” This “accent,” or foot in the past, ranges from printing out their emails (or having their assistant print them – an even heavier accent) to not using the web to find information, to not understanding many of the things the Digital Natives take for granted, such as various forms of connectivity and ways to do things online.

Currently, the senior leadership of the US military is almost entirely made up of “Digital Immigrants,” as is the bulk of our teacher and trainer corps. This often leads to frustration from Digital Natives when the Immigrants don’t understand what they are asking for or why it is important to them. Many individuals who have tried to initiate programs which involve digital experiences such as games have experienced resistance from this group. They often report having difficulty finding high ranking officers who “get it,” enough to support certain types of unconventional “Digital Native” – oriented approaches. Yet when Immigrants do support such programs, they can often be quite successful, as the *America’s Army* recruiting game clearly demonstrates.

At this time, the US military is struggling to make itself as digitally advanced as possible, and to understand and fully exploit the implications for its mission of such digital age things as smart weapons, network centric warfare, asymmetric information capabilities, and other highly digital age concepts. Are there skills, thinking patterns and/or behaviors that Digital Natives possess by virtue of the experiences they have had that can inform and help with this process? Might this perhaps include things that our Digital Immigrant leaders cannot do themselves and therefore wouldn’t expect from others? Are there new skill sets or thinking patterns that the military might be overlooking or not recognizing?

Put another way, have all the tens of thousands hours of video game playing and other digital experiences that the young people of today experienced affected in any ways their ability to be effective soldiers, sailors, airmen and officers?

It is high time that we asked these questions. The goal of this paper is to lay out some experiments that will help answer them.

I will begin by briefly reviewing what research has been done up to this point, and then will lay out the broad outlines of a course of research for the next year. It is my hope that a year from now I can come back with some better data on these important issues.

## PREVIOUS RESEARCH

The specific questions that I am attempting to ask and answer are the following:

1. What military-related skills, if any, have been enhanced by “growing up digital?” (“Skills” is defined broadly, to include physical abilities, mental abilities including thought and reasoning, and interpersonal skills including leadership and teamwork.) Does this vary by time spent, or by other factors? If so, how?
2. What skills, if any, have been decreased or lost in the process?
3. Are there effective ways to use the digital technology that the Natives grew up with to enhance these skills even further, or to create them in people in whom they may be lacking?

One reason I am undertaking this study is that there does not exist an extensive body of research on these topics. Yet some of these questions have been addressed by a small group of researchers, both directly and indirectly.

Directly applicable research includes that of Professor Daniel Gopher of the Technion Israel Institute of Technology, Professor Patricia Greenfield of UCLA, Professor Emmanuel E. Donchin of the University of Illinois, and Associate Professor Daphne Bavelier of the University of Rochester.

These researchers have all found that certain Digital Native experiences, such as playing video games, for example, *do* have an effect on people’s skills.

Some of the studies are older, from a time when people with “truly Native” digital experiences (i.e. having been exposed to digital technology all their lives) had not yet emerged. Yet effects were still observed. One of Professor Gopher’s studies, conducted in 1982, involved pilots in the US and Israeli forces. He constructed a video

game that was relevant to the flying skills the pilots used. Gopher found that while the Israeli pilots’ skills improved from playing the game, the American pilots’ skills did not. He attributed this to the fact that the Americans already had experience playing the games, and so had already experienced the improvement effect.<sup>7</sup>

Beginning 1984, Psychology Professor Patricia Greenfield found changes in cognitive skills as a result of playing video games. For example, thinking skills enhanced by repeated exposure to computer games and other digital media included reading visual images as representations of three-dimensional space (representational competence), multidimensional visual-spatial skills, mental maps, “mental paper folding” (i.e. picturing the results of various origami-like folds in your mind without actually doing them), “inductive discovery” (i.e. making observations, formulating hypotheses and figuring out the rules governing the behavior of a dynamic representation), “attentional deployment” (such as monitoring multiple locations simultaneously), and responding faster to expected and unexpected stimuli.<sup>9</sup>

Much more recently, in a May 2003 article in *Nature* entitled “Action Video Game Modifies Visual Selective Attention,” Cognitive Science Professor Daphne Bavelier and her student C. Shawn Green found that action-video game playing is capable of “radically” altering a range of skills, including increasing players’ visual attentional capacity and task-switching ability.<sup>10</sup>

While none of these researchers has identified (or even looked for) any “new” skills that have emerged as a result of video game playing, they have demonstrated that the particular combination and intensity of certain existing skills *is* new, indicating that we may now have a new generation of war fighters with a different blend of cognitive skills than its predecessors.

## INDIRECT RESEARCH

There also exists a larger body of research that indirectly points to possible effects of the high frequency of digital experiences (such as those described in paragraph 1 of this article) on the Digital Natives. This research includes studies on neuroplasticity such as the following:

- Rats raised in “enriched” environments showed brain changes compared with

those in “impoverished” environments after as little as two weeks. Sensory areas of their brains were thicker, other layers heavier. Changes showed consistent overall growth, leading to the conclusion that the brain maintains its plasticity for life.<sup>11</sup>

- Ferrets’ brains were physically rewired, with inputs from the eyes switched to where the hearing nerves went and vice versa. Their brains changed to accommodate the new inputs.<sup>12</sup>
- Imaging experiments have shown that when blind people learn Braille, “visual” areas of their brains are activated. Similarly, deaf people use their auditory cortex to read signs.<sup>13</sup>
- Scans of brains of people who tapped their fingers in a complicated sequence that they had practiced for weeks showed a larger area of motor cortex becoming activated then when they performed sequences they hadn’t practiced.<sup>14</sup>
- Japanese subjects have been able learn to “reprogram” their circuitry for distinguishing “ra” from “la,” a skill they “forget” soon after birth because their language doesn’t require it.<sup>15</sup>
- Additional languages learned later in life go into a different place in the brain than the language or languages learned as children.<sup>16</sup>
- Intensive reading instruction experiments with students aged 10 and up appear to have created lasting chemical changes in key areas of the subjects’ brains.<sup>17</sup>
- A comparison of musicians versus nonplayers brains via magnetic resonance imaging shows a five percent greater volume in the musicians’ cerebellums, ascribed to adaptations in the brain’s structure resulting from intensive musical training and practice.<sup>18</sup>

Indirect research also includes strong evidence from social psychology that one’s thinking patterns change depending on one’s experiences. Research by social psychologists<sup>19</sup> shows that people who grow up in different cultures do not just think about different things, they actually *think differently*. The environment and culture in which people are raised affects and even

determines many of their thought processes. “We used to think that everybody uses categories in the same way, that logic plays the same kind of role for everyone in the understanding of everyday life, that memory, perception, rule application and so on are the same,” says one. “But we’re now arguing that cognitive processes themselves are just far more malleable than mainstream psychology assumed.”<sup>20</sup>

We now know that brains that undergo different developmental experiences develop differently, and that people who undergo different inputs from the culture that surrounds them think differently. And while we haven’t yet directly observed Digital Natives’ brains to see whether they are physically different (such as musicians’ appear to be) the indirect evidence for this is quite strong.

### **GOING FURTHER – PROPOSED RESEARCH AT THE USNA**

In order to go beyond both the indirect evidence and the rather narrow scope of the direct studies conducted to date and address the broader questions described above, I am proposing a program of research to be conducted during the 2003-2004 academic year at the United States Naval Academy. Officers at the Academy are receptive to the idea, and we are currently engaged in discussions as to how and when to implement the program.

The research will have several parts.

- (1) Focus Groups. In focus groups held separately with “Digital Native” Midshipmen and older officers and professors, I will attempt to identify and classify as many observed differences as possible that are potentially attributable to “growing up digital.”
- (2) Individual Interviews. I will attempt to further refine differences and identify their sources.
- (3) Hypothesis generation. I will generate a series of hypotheses that directly relate to military-related skills and behaviors. Such hypotheses might include, for example, that Digital Natives have increased ability to take in information sources and form a coherent COP, or increased ability for shared situational awareness.

- (4) Experimental Design. In collaboration with military-based research scientists with specialties in Cognitive Psychology and Neurology, I will devise a set of experiments to test the validity of my hypotheses. This may involve the development of new measurement tools, as existing tests of cognitive abilities may not prove adequate for measuring these new digital skills.
- (5) Testing of Midshipmen (and possibly of officers at the academy or elsewhere.)
- (6) Analysis of findings.

### EXPECTED RESULTS AND REPORTING

By IITSEC 2004 I expect to have identified a set of potential military-related skills that have been enhanced by the process of growing up in a digital world generally, if any, and those that have been enhanced by a high level of video game playing in particular. These results should prove useful to a military that is increasingly composed of Digital Natives, and that is increasingly using games and other digital means for both training its people and conducting its missions.

### REFERENCES

1. These numbers are intended purely as “order of magnitude” approximations; they obviously vary widely for individuals. They were arrived at in the following ways ( Note: I am very interested in any additional data anyone has on this):

*Videogames:* Average play time: 1.5 hours/day (Source: “Interactive Videogames, *Mediascope*, June 1966.) It is likely to be higher five years later, so  $1.8 \times 365 \times 15 \text{ years} = 9,855 \text{ hours}$ .

*E-mails and Instant Messages:* Average 40 per day  $\times 365 \times 15 \text{ years} = 219,000$ . This is not unrealistic even for pre-teens – in just one instant messaging connection there may be over 100 exchanges per day – and most people do multiple connections.

*TV:* “Television in the Home, 1998: Third Annual Survey of Parent and Children, Annenberg Policy Center, June 22, 1998,

gives the number of TV hours watched per day as 2.55. M. Chen, in the *Smart Parents Guide to Kid’s TV*, (1994) gives the number as 4 hours/day. Taking the average,  $3.3 \text{ hrs/day} \times 365 \text{ days} \times 18 \text{ years} = 21,681$ .

*Commercials:* There are roughly 18 30-second commercials during a TV hour.  $18 \text{ commercials/hour} \times 3.3 \text{ hours/day} \times 365 \text{ days} \times 20 \text{ years (infants love commercials)} = 433,620$ .

2. *Reading:* Eric Leuliette, a voracious (and meticulous) reader who has listed online every book he has ever read, ([www.csr.utexas.edu/personal/leuliette/fw\\_table\\_home.html](http://www.csr.utexas.edu/personal/leuliette/fw_table_home.html)) read about 1300 books through college. If we take  $1300 \text{ books} \times 200 \text{ pages per book} \times 400 \text{ words per page}$ , we get 10,400,000,000 words. Read at 400 words/minute, that gives 260,000 minutes, or 4,333 hours. This represents a little over 3 hours/book. Although others may read more slowly, most have read far fewer books than Leuliette.

3. The term “Digital Natives” was first used by me in Prensky, Marc (2001) *Digital Game-Based Learning* (McGraw Hill), p. 316. It was further expanded in the articles Prensky, Marc (2001) *Digital Natives, Digital Immigrants* *On The Horizon* Vol. 9 No. 5, October 2001 and *Do They Really Think Differently?* *On The Horizon* Vol. 9 No. 6, December 2001. Both online at [www.marcprensky.com/writing/default.asp](http://www.marcprensky.com/writing/default.asp).

4. The title of a book by Don Tapscott: Tapscott, Don (1998) *Growing Up Digital*, (McGraw Hill). Nicolas Negroponte, then Director of MIT’s Media Lab, wrote “Being Digital” in 1995: Negroponte, N. (1995) *Being Digital* (Vintage).

5. Others who have proposed such hypotheses include Dr. John Seely Brown, former head of the Xerox PARC Research Center, and Psychologist Patricia Greenfield of UCLA.

6. Personal briefing. Quoted in Prensky, Marc (2001) *Digital Game-Based Learning*, *op. cit.*, p. 316.

7. Prensky, Marc (2001) *Digital Natives, Digital Immigrants*, *Op cit.*

8. Gopher, Daniel (1982) A selection attention test as a predictor of success in flight training, *Human Factors* **24**, pp. 173-183.
9. Greenfield, Patricia Marks (1984) *Mind and Media, The Effects of Television, Video Games and Computers*, Harvard University Press.
10. Green, C. Shawn and Daphne Bavelier (2003) Action Video Game Modifies Visual Selective Attention *Nature* 423 pp. 534-537.
11. Research by Dr. Marian Diamond, reported in Caine, RN and G. Caine *Making Connections: Teaching and the Human Brain*, Addison-Wesley, 1991, p.31.
12. Sur, Dr. Mriganka (2000) *Nature*, April 20, 2000.
13. Blakeslee, Sandra (2000) *The New York Times*, April 24, 2000.
14. Leslie Ungerlieder, National Institutes of Health.
15. James McLelland, University of Pittsburgh.
16. Cited in *Inferential Focus Briefing*, September 30, 1997.
17. Berninger, Virginia (2000) University of Washington, *American Journal of Neuroradiology*, May 2000.
18. Tramano, Dr. Mark Jude, Harvard. Reported in *USA Today* December 10, 1998.
19. They include Alexandr Romanovich Luria (1902-1977), Soviet pioneer in neuropsychology, author of *The Human Brain and Psychological Processes* (1963), and, more recently, Dr. Richard Nisbett of the University of Michigan.
20. Dr. Richard Nisbett, University of Michigan. Quoted in Erica Goode, "How Culture Molds Habits of Thought," *New York Times*, August 8, 2000.