Combating the Inevitable Aging of Software Developers

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Abstract. One of the immutable laws of software evolution is that the developers, along with the software, require sustainment. New college grads are typically drawn to newer technologies and innovative mobile applications. The DoD has software applications that have lifecycles measured in decades, rather than months. The DoD has skilled developers and program managers who have years of valuable experience in the development and sustainment of these long-lived software programs—and these developers and managers are a valuable commodity that cannot easily be replaced. With age comes wisdom, but also, with age comes inevitable decreases in some skills. This article will summarize the effects of aging on computer use, and discuss the proactive steps that can be taken to combat these negatives effects and prevent a decrease in the effectiveness of computer usage skills due to age.

The Inevitable Aging Process

Since the dawn of human civilization man has been seeking the fountain of youth. This insatiable desire to avoid aging has not lessened in modern times. A quick look at plastic surgery trends discussed in three sources gives us a general idea of the desire to look better and younger. Note that the trends are for 2010, the most recent year of released statistics and refer only to the United States[1]:

• Approximately $10.1 billion was spent on plastic surgery in the year.
• There was a 77% increase in procedures from 2000 to 2010.
• Plastic surgery procedure demands increased almost 9% from 2009.
• Approximately 13.1 million cosmetic procedures were performed in 2010.
• Of those procedures, 48% were performed on individuals between 40-54 years old and 25% on individuals 55 and older.

Clearly, people do not want to look older and for good reason. Looking older makes people treat you differently. Pat Moore, a renowned industrial designer and gerontologist spent approximately three years disguised as an 85-year-old woman. When she started her experiment she was only 26 years old.

Pat Moore learned from a professional makeup designer how to create the impression that she was an old woman. Besides extensive makeup she went to such lengths to act old that she taped her fingers to better imitate arthritis and added restraining devices to her back, hips, and legs to better imitate an old woman.

In the end she found that simply looking older makes a dramatic difference in how people treat you. She visited 116 cities in 14 states and two Canadian provinces. She found that with a few, subtle, subcultural exceptions, older people are universally more ignored, thought more incompetent, and less able to perform[2].

There are additional reasons for not wanting to appear older. While there are laws in place to prevent discrimination on the basis of age, there are subtle actions that can result in older workers being forced out of the workplace. For example, older workers generally will command higher salaries as a result of their greater experience; as a result, many hiring managers are inclined to bypass these candidates because of budget considerations. Additionally, there is a growing perception that older workers represent a bigger risk to companies in lost productivity due to medical problems and associated sick days.

Another phenomenon we are currently experiencing is a growing divide in the demographics of the workplace. We now have four generations in the workplace; the Millennials, born between 1980 and 2000; the Gen X'ers, born between 1960 and 1980; the Boomers, born between 1943 and 1960; and the Traditionalists, born between 1922 and 1943. The Millennials have grown up with electronic devices and expect instant gratification - they are very focused on technology. The X'ers are technologically literate, but are very jaded, having grown up with Watergate, the energy crisis, and Desert Storm. The Boomers are very team oriented, but are also driven by a high need for personal gratification. Finally, the Traditionalists are marked by dedication, sacrifice, and a "duty before pleasure" attitude.

These differences may create situations in which generational interactions and acceptance of new technologies in the workplace could be difficult, possibly resulting in confrontations. For example, Traditionalists and Boomers tend not to question authority, but the X'ers and Millennials have been taught to speak up and question authority. Indeed, the two younger generations tend to value recent contributions (what have you done for me lately?) and expect instant feedback, while the older generations value historical contributions, and accept annual (or no) feedback as the norm (no news is good news). These differences can also show up when workers interact with technology, as the Boomers and Traditionalists can be highly resistant toward accepting changes in the form of new technology[3]. While the Millennials and X'ers have different life experiences and communicate with people differently than the Boomers and Traditionalists, there is potential for synergism if they can find ways to exploit those differences.

There are also certain physical and psychological things that happen to us as we age. As we age, there is progressive denaturation of the lens proteins, and the lens becomes thicker and less elastic over time that produces a medical condition called "presbyopia." The result of those changes in the lens is the loss of the ability to change its refractive power, so we cannot change our focus from near to long distance. The

refractive power of the lens gradually decreases from about 14 diopters in children to less than two diopters by the time we are 50, and essentially zero diopters by age 70 where the eye becomes fixed focus. This denaturation also affects the optical clarity of the lens, reducing the amount of light transmitted to the retina and distorting color perception as well[4].

The Benefits of Mature Developers

Since our physical eyesight degrades as we age, we would expect that younger adults would be able to read and comprehend what they read faster. However, luckily this is NOT the case. While it is true that older adults do not read at the same speed as younger adults, what is also true is that older adults usually read (and comprehend) faster[5]! Based on crystallized intelligence, people read faster the older they get, as long as they continue to read throughout their lifetime.

Crystallized intelligence is the ability to use skills, knowledge, and experience and is related to verbal ability and the ability to come up with strategies to complete tasks[6]. As long as a person continues reading throughout his life (so that reading skills do not degrade simply due to lack of practice), their reading comprehension and speed also improves. Because of this, older adults read faster in general than younger adults.

Fluid intelligence is the ability to deal with new situations independent of acquired knowledge. Although both types of intelligence increase during childhood and the teenage years, fluid intelligence begins to decline between the ages of 30 and 40 (for most people). However, crystallized intelligence continues to grow throughout adulthood and begins to decline only very late in life.

In other words, an older person may not be able to learn how to do something new as quickly as younger people because of the youth-related advantage in fluid intelligence, but an older person generally can perform a familiar task better and faster than younger adults because of crystallized intelligence.

Do older adults read faster than younger adults on a computer? It turns out that if the font size of the computer is sufficient for the older person's eyesight, then, yes, older adults do read faster than younger adults from computers. In addition, what most people do not realize is that reading from computers is not slower than reading from paper these days. With today's crisp displays, reading from paper and from computers no longer provides a statistical difference in performance. While reading speed may not be statistically different, there is often a preference among older workers to read from paper instead of computer screens. The degree of preference is related to the amount of experience with reading from computers versus paper[7].

There are also a number of other benefits from using larger displays. Using larger displays allows you to see more of the data you are analyzing. Larger displays that show more data at once have been shown to allow people to understand the data faster and to a greater degree of comprehension[8].

Coupling that research with the greater experience and wisdom—crystallized intelligence—that comes with years of working in industry produces a synergistic effect when you can see more data at once. Being able to see more data at once enhances the older person's advantage over youth.

In addition, having a greater view of the data allows one to see and comprehend the data in new and innovative ways. A research study was performed in which expert video gamers were asked to play the same strategic game on different sized displays. They found that the larger the display, the better the strategy the gamers were able to employ and the more they won[9]. Is not "winning" at business often no more than simply understanding the business data and coming up with better strategies than other businesses?

Combating Age-related Skill Deterioration

There are always technological innovations to help productivity. The problem is often that there are too many new technologies to evaluate. A key point to remember about new technologies is that there is a company behind every product. In addition, there is usually a marketing team that works for that company that wants to sell you the technology. The company wants you to think that you have to buy the technology; they want you to think that you cannot solve your problems without it.

There are several extremes that people tend to follow in regard to technology. The first type we call The Hammer. The Hammer is the person who is content to use a familiar technology rather than learn another which might be better.

A famous quote often called the law of the instruments is "If all you have is a hammer, everything looks like a nail."[10] Obviously one technology will not fit all needs, but this type of person tries to accomplish all business tasks with the one piece of technology he already knows.

A variant of the type of person that does not want to accept new technology is The Self-Fulfilled Prophesier. The Self-Fulfilled Prophesier believes that before they have seen or used the new technology—regardless of what it might be—that they will not be able to learn to use it. This person subconsciously and consciously acts in ways that cause him to fail. They fail in learning to use the technology and it reinforces their negative view that they cannot learn new technologies. According to psychology experts, this self-fulfilling failure often actually makes the person happy that he failed[11].

The other extreme is The Marketer. The Marketers embrace all new technology simply because it is new. In our experience they tend to follow one technology company more than others. They absolutely must have any new technology that the particular company introduces.

The Marketer always has the newest, fastest technology, and will tell anyone that will listen why it is the best and why they should buy it, too. In effect, they become an unpaid part of the marketing team of that technology company.

The key to using technologies (both old and new) is to view them as tools for accomplishing a particular task. New technologies come out constantly. If the technology is not useful in helping one accomplish a task, then it is simply a toy to be played with—but not useful technology. On the other hand, if a new technology can be used to help you accomplish a particular task, then the new technology becomes a useful tool.

It is not necessary for a person to learn to use every idea that comes from technology companies. Some of these "new technologies" turn out to be nothing but a toy. On the other hand, it is not wise to fear or ignore new technology. Some "new technologies", when examined, become useful tools. It is also worth

noting that these experiences are different for different people. Some individuals will examine a new technology, and discard it as worthless—it is only a vaguely interesting toy. Others, however, will find the new technology interesting and useful—a tool that will multiple their productivity.

For these reasons, neither the Hammer, the Prophesier nor the Extremist viewpoint is correct. Learn the tools that you find useful to help fulfill your tasks and ignore all the toys that accumulate around you. Of course, also be flexible, so that if one of those toys turns out to have potential value, then you would be willing to learn how to use them. The following are "tried and true" technologies that can increase productivity and combat any age-related decreases in certain skill areas.

Physical Adaptations: Monitors

As explained above, our eyes change as we age. Vision declines with age in five dimensions: visual processing speed, light sensitivity, dynamic vision, near vision and visual search[12].

Increasing the size and quality of the monitor can alleviate many of these declines. An aging 17-inch CRT monitor is no match for a crisp, clear, bright 40-inch LCD monitor. Why stop at 40 inches? Why not move up to a 90-inch LCD monitor?

There are several reasons that bigger is not always better. First, the cost of a 90-inch monitor approaches $5,000 or more. A 40-inch monitor can easily be bought for less than $500.

Also, the size of the work area necessary for a 90-inch monitor is not usually feasible due to the second reason—optimal viewing distance. The recommended minimal viewing distance for a 90-inch monitor is more than 8 feet! Indeed, a 40-inch monitor has a minimal distance of 3 to 4 feet, depending upon the light source. A reasonable 30-inch monitor, however, costs less than $250, has a minimum viewing distance of 2—3 feet, and requires little more room than the bulky 17-inch CRT.

Pixel density determines optimal viewing distance. Most contemporary 90-inch monitors have approximately the same number of pixels as a much smaller monitor, thus the larger monitor shows the same amount of data, but the data is just shown physically larger.

Another advantage of feature-rich newer LCD monitors includes increased clarity and brightness of the display. Increased brightness translates into small pupil size, providing increased "depth of field" for aging viewers. This is why older persons typically need a brighter reading environment than younger people—it gives them increased clarity. In addition, the non-interlaced LCD display provides a higher resolution (discussed below), helpful for watching videos or browsing the Internet without the "flickering" that was part of the CRT-era viewing experience.

Often, a more economical solution is to use multiple, smaller monitors. Numerous studies have shown that use of more than one monitor can drastically increase the productivity of people of all ages. Studies confirm a clear pattern of improved information processing. Using multiple monitors allows users to significantly increase the amount of information they can process. Results show that multiple monitors increase comprehension, and that this increased comprehension leads to increased task performance. Recent studies support the increased utilization of multiple monitors[13].

A suggestion on how to leverage the effectiveness of multiple monitors is to use dedicated monitors for increased productivity[14]. For example, email could always be on one monitor, and word processing would be accomplished on another. A popular approach is to use a monitor that rotates for a document view (e.g. a traditional-sized monitor rotated 90 degrees, to resemble the size of a typical page of a document) and another monitor, aligned the normal way, for email and other tasks. It is worth noting that a rotating 27-inch monitor is currently less than $200 and has an optimum viewing distance of less than three feet. For less than $500 a dual monitor setup of very high quality can be obtained.

The above studies suggest that the next time you upgrade your computer system you may want to pay more on upgrading your monitor(s) than your computer speed. When it comes down to total task performance time, larger monitors can help you accomplish your goals faster than a faster computer[15].

Physical Adaptations: Increasing Readability

If you have a hard time reading from computer monitors, there are a number of changes that you can make to your environment to improve the situation. One option is to increase the size of the text and icons on the display. The three most popular operating systems (Windows, Macintosh, and Linux) all permit the user to increase text and icon size.

In addition, you can also lower the screen resolution, which also increases the size of what is shown. Lowering the resolution limits the amount of data that can be displayed at a time, but it always increases the size of all the data for easier viewing.

The aging user should also experiment with display brightness and contrast to find the optimum setting that makes viewing comfortable and effective. Note that on computers with multiple monitors, each monitor can be set to a different brightness and contrast, permitting one screen to be used for videos (lower contrast) and one for document and email (higher contrast). Some users might find that reducing color saturation (moving to black-and-white or grey-scale) might be the optimum setting for long-term textual viewing and editing.

One additional tactic that can be used to fight the effects of aging on vision is increasing the size and "trail" of the mouse and pointer icon. All operating systems allow for easily increasing the size of the mouse, and changing the color to make it more visible. Also, you can adjust the computer setting so that the mouse leaves a "trail" as it moves, making it easy to follow visually. On Windows systems one can set the mouse/pointer icon to flash when the Control Key is pressed, making it easy to find on a cluttered screen.

Often, aging computer users are faced with reading websites or documents designed by those who have little understanding of font legibility. Faced with a website in Comics Sans or one written in PLAYBILL, decreasing visual acuity can hinder understanding. Aging computer users need to be aware that many, if not most, applications allow substitution of a more legible font for one that is not readable. Research performed on message legibility has not come to a clear conclusion as to which factors make a font legible[16].

Our advice to the aging computer user is to find a set of fonts that allow for easy readability. Other features, such as font size

and color, background, bold vs. non-bold, italicized fonts, etc., also affect readability. Different documents and types of computer use might require different fonts and color settings. Do not be afraid to experiment.

Physical Adaptations: Reduce Eyestrain

James Sheedy, director of optometric research at the Vision Performance Institute at Pacific University Oregon, put computer vision syndrome on the map two decades ago when he began to publish scores of studies on computers and vision[17]. It has been called a modern epidemic. Symptoms include eyestrain and fatigue, double or blurred vision, dry or irritated eyes, and aches in the head, neck and/or back (from improper head positioning). What distinguishes this from more generic eye complaints is that when the sufferer stops using a computer, the symptoms tend to disappear or greatly subside.

One reason that many users have "computer vision syndrome" is a simple one—many computer users either lack or have incorrect glasses for continuous, close-in computer viewing. A common mistake is to believe that bifocals will suffice. In fact, bifocals will often not only cause eyestrain, but due to the user constantly holding their head at a less-than-optimal angle, neck strain will also result[18]. A simple visit to an eye doctor can provide the computer user with glasses designed for computer use. It has been shown by an University of Alabama study that it is cost-effective for the employer to provide computer users with eye care and specific glasses to prevent eye fatigue, with a cost/benefit ratio of over 2:1[19].

Other possible adaptations to reduce eyestrain include[20]:
• Upgrade to glare-free lighting. Overhead fluorescent lights should be indirect, or have louvers to diminish the brightness of the light source. Avoid a high contrast between your computer screen and room lighting by lowering bright light sources and adding blinds to windows or adjusting the brightness of the screen. Task lighting can help illuminate text if necessary. The University of Alabama studies, above, have also shown that florescent lighting is far superior to incandescent bulbs.
• Place your monitor straight ahead, an arm's length away when you are sitting in front of it, where you can view the middle of the screen without tilting your head up or down. Position the monitor perpendicular to windows, and keep your screen clean to reduce blurred vision.
• Use corrective lenses that allow clear viewing of the screen. That might mean a special pair of glasses that you use just for the computer. (Bifocals and progressive lenses might cause you to tilt your head back to see, which can lead to poor neck posture.)
• Take regular breaks. Follow "the rule of 20s": Every 20 minutes, stand up, walk to a window if you have one, and look 20 feet away from your screen for at least 20 seconds. Note that such breaks can be productive: they are an ideal time to make phone calls, catch up on face-to-face meetings or review printed material.
• Blink often - it moistens the eyes. In one study, Sheedy[21] found that computer users' blink rate dropped 50 percent when they were staring at a monitor (from 15 per minute to seven and a half). This definitely contributes to dry eyes.

• Avoid squinting. This happens far more often than you may realize because you cannot see the screen clearly (or the screen is too bright) or because of glare. Another cause could be improper vision correction. All of these can lead to eyestrain.
• One way to reduce eyestrain is to occasionally "sooth your eyes." Rub your hands together briskly to create heat, then palm your eyes by placing the heel of your hands on your cheekbones and fingertips in your hairline. Without pressing on the eyeball, block out all light and allow the warmth to soothe the eyes. A good eye exercise — for everyone — is to imagine a large clock in front of you. Without moving your head or straining in any way, let your eyes trace a slow clockwise circle, then a counter-clockwise one. Close your eyes and rest them[22].

Physical Adaptations: Ergonomics and Physical Environment

Poor usage of the keyboard and mouse can lead to significant medical problems (e.g., carpal tunnel syndrome). Many computer users believe that switching to an ergonomic keyboard and an alternative pointing device such as a trackball or a trackpad will alleviate this problem. However, this is not universally the case[23]. In fact, many ergonomic keyboards simply change the musculoskeletal region exposed to risk, instead of eliminating hazardous postures. Regardless, it is generally accepted that an ergonomic keyboard minimizes the potential for carpal tunnel syndrome, even though there are not any universally accepted benefits. Proper posture and correct typing skills are most likely equally effective. It boils down to which type of keyboard enables the user to type faster and more accurately.

Alternative pointing devices likewise do not have clear advantages in terms of preventing strain or injury. Nevertheless, they have their place. Many computer users feel often that a trackball or trackpad is not as tiring as using a mouse, especially after a long period of use. However, there is a learning curve associated with these alternative pointing devices; do not expect computer users to become accustomed to them without a "break-in" period. Another common solution is to switch the hand that you use for the mouse. For example, it is not uncommon for some people to alternate from one hand to the other every month to alleviate any problems in that hand. Note, however, that there is a steep learning curve for a person who has used their mouse with their right hands for many years when they attempt to user the mouse with their left hand. Personal experience on the part of one of the authors (due to carpal tunnel syndrome) suggests that it takes several months for "wrong-handed mousing" to feel natural or be accurate. The author eventually learned to use one hand for the mouse, and another for the trackpad—and both now feel natural. It is possible that the brain is better able to adapt to separate hands for separate pointing devices, but a search of the literature has revealed no published evidence for this.

Along with optimum viewing distance for monitors, one also needs adequate space for keyboards and the mouse. The user should not be cramped in terms of elbow room or room to use the mouse. There should also be enough space for the user to use the keyboard correctly[24].

Although most people are well aware of the more common problems with keyboard ergonomics, there are many other areas to consider as well. For example, one should sit on an adjustable chair and raise or lower it until thighs are parallel to the ground. This helps alleviate potential knee problems with chairs that are too high or low. In addition, one of the easier solutions to neck pain, besides good posture, is to have the top of your monitors level or slightly lower than your eyes.

Last, as we age, our hearing tends to deteriorate, a condition aptly termed "age-related hearing loss[25]" occurs. The small, tiny speakers included in many laptops and desktop computers no longer generate the desired volume (or acoustic clarity) when such hearing loss occurs. Typically, a set of reasonably inexpensive speakers (approximately $25) is all that is necessary for the aging computer user to regain the ability to hear computer-generated audio clearly. If working conditions would make using speakers infeasible, a moderately inexpensive set of headphones ranging from in-the-ear headphones at $10 to over-the-ear higher-quality headphones at $40 will make listening to audio clearer, easier, and comfortable.

Summary

No matter how hard we try, developers grow older. There is no miracle fountain of youth that will stop you from aging. Fortunately, there is a silver lining to aging. Being older also means having more experiences and usually greater wisdom. Equipped with larger, crisper monitors and the greater experience and wisdom that you have can be used to make you even more valuable to your business as time goes on. The increased value of crystallized intelligence can easily offset the slight deterioration of fluid intelligence.

As a manager, do not expect your workforce to stay young. Increase the productivity of your existing workforce by adapting their environments to their needs. Do not expect the workers to adapt to physical changes—instead provide an environment that adapts to their individual needs. The important point is that computer technologies are tools to help your developers perform their job. Personalize your environment by adjusting settings, using different devices, and other adjustments to improve their performance, instead of letting the environment restrict performance.

You should choose new technologies that will increase your efficiency (such as larger monitors). Finally, do not overlook the value of crystallized intelligence that will allow increased performance from computer users in spite of advancing age. ◈

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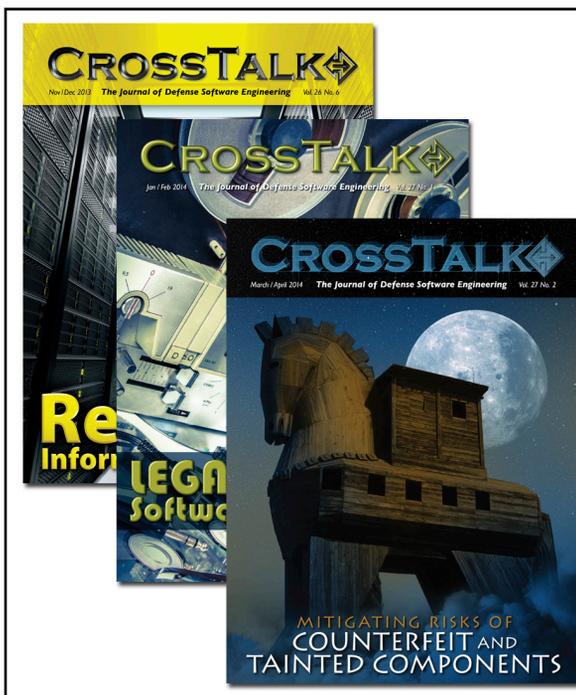
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NOTES

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