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Has Human Factors and Usability Lost Its Mojo?

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Introduction

The human factors and usability community has contributed greatly to the safety, usability, and general acceptance of systems over the last 70 years. The tireless work of countless researchers and practitioners has had a significant positive impact on society.

Although there are untold numbers of success stories where human factors and usability professionals have made important contributions, there are areas where our work has failed to live up to its potential.

Where Has Human Factors Had a Large Impact?

Reduction in aviation accidents. When Alphonse Chapanis, widely considered to be the father of human factors, demonstrated that the designs of systems could cause people to use them incorrectly, he set in motion a profession that would dramatically change the aviation industry. As you may recall, Chapanis determined that pilots were inadvertently activating a control that raised the landing gear during landing, confusing it with a control that operated the flaps, because these two controls were similarly shaped and next to each other. His suggested design: a landing gear control that looked and felt like a landing gear that persists today in modern aircraft. Human factors and usability professionals have been intimately involved in the design and operation of aircraft ever since. This involvement has helped push the overall rate of aircraft fatalities (as measured by fatalities per million passenger boardings) down 96% since 1970 (Savage, 2013), making air travel the safest form of transportation.

Reduction in automobile accidents. Similar to the amazing trend seen in aviation, fatalities related to motor vehicles have also dramatically fallen over the years. After Ralph Nader brought significant attention to the issue of automobile safety with his book *Unsafe at Any Speed* (1965), human factors professionals have been working to make automobiles incredibly safe. Since 1975, automobile fatalities per hundred million vehicle miles traveled have decreased by almost 67% (Savage, 2013), due in large part to safety advances like seatbelts, airbags, traction control systems, and antilock brakes, that have been advocated by human factors professionals.

Increased adoption rates of technology. Rogers (2010) has noted that ease of use is one of the factors that determines the degree to which a particular technology is adopted by the public, and the speed with which that adoption occurs. When products are easy to use, consumers are more willing to expend the effort necessary to learn the operation of the device and integrate it into their daily lives. The pace of adoption for technological innovations has been increasing very rapidly over the last 100 years as technology has become easier to use. Look no further than the smartphone as an example of this increased speed of adoption: It took less than 5 years for the smartphone to reach a 25% adoption rate, while the personal computer took more than 15 years (McGrath, 2013).

The long list of success stories like these are indicative of a profession that has matured to the point where its cumulative body of knowledge has become a common base upon which new improvements are made. The metaphorical wheel doesn't have to be reinvented with each new problem, and continuous improvement to the usability and safety of these systems has been made over time.

What Are the Problems We Have Failed to Solve and Why?

Unfortunately, there are many areas where this continuous improvement in usability and human factors doesn't seem to be taking place. It is almost as if we are approaching every new system design without taking the lessons from past efforts into account, creating new (suboptimal) solutions to problems we have already solved before. Here are some of the areas where human factors and usability seem to be struggling to improve these mature systems.

Website usability. It has been almost 18 years since Nielsen published his seminal book *Designing Web Usability* (1999) that laid out in great detail how to design a highly usable website. However, the usability of websites, particularly new ones, continues to be a significant issue. The very public failure of the first generation of the website where Americans signed up for the Affordable Care Act (Healthcare.gov) is a classic example. Regardless of your feelings about the Affordable Care Act, it is remarkable that a website that had significant development resources devoted to it (over $2 billion by some estimates; Wayne, 2014) would fail so dramatically. As a profession, we should all be greatly concerned that a relatively straightforward informational and transactional website could not be produced with minimal design flaws.

Certainly, there were technical issues with the site (which also impacted users' ability to use the site), but there were a number of fundamental usability issues associated with the interface itself that made the site extremely difficult to use. The website was supposed to allow simple

transactions and information finding, but the user interface made that task extremely difficult. The science behind the design of good and functional webpages has been well-established for over two decades. Volumes have been written on how to design good webpages and construct transactional websites that are easy to use and robust against error. Unfortunately, the introduction of websites, both transactional and informational, that are difficult to use is still a common occurrence.

Many of the issues surrounding the poor usability of websites are due to feature creep. We keep expanding the number things that you can do on a webpage. While this has made the web a more powerful tool, it has also added to the complexity and increased the difficulty in creating easy to use websites. Another likely culprit in the decline of web usability is the fact that the web has become much more than a utilitarian means to gather information. It has also become a marketing tool where design has begun to take precedence over usability and utility. Designers want to implement something "cool" and so they push the limits of the browsers and the code in order to achieve their artistic vision, often at the expense of ease-of-use and interoperability. As we have moved away from usability to user experience, many of the important lessons that were based in science have given way to aesthetic concerns.

Software usability. As with the web, the usability of software does not seem to be improving with time. Many of us nostalgically recall the ease-of-use of the first version of Mac word, where a simple set of menu items would allow you to produce basic documents. Few would say that about the modern feature-laden versions that often seem to have a mind of their own. In 2003 Bill Gates presciently noted in an interdepartmental memo that he was "quite disappointed at how Windows usability has been going backwards…" (Bishop, 2008), a concern that seemed to come to life when users expressed significant dissatisfaction with the usability of Windows 8 due to the introduction of touch and its radical departure from fundamental interface elements contained in the previous operating systems.

In the software world, feature creep is probably the reason usability difficulties continue to present themselves. Early versions of Microsoft Word had only a handful of menu options for the user. By my count, a recent version of Word has over 250 menu options on the page layout ribbon alone. This isn't to say that the added functionality isn't good or necessary; only that it complicates a user's ability to easily find and use the tools of their choice. Indeed, it has been noted that 20% of the features in a given software program are rarely used and 45% are never used, suggesting that users are simply overburdened with interface "noise" as they search for the features they need (Collier, 2011).

Reversal of automobile fatality decline? One of the more intriguing potential usability and human factors failures is the recent rise in fatalities due to automobile crashes. As noted earlier, there has been a steady decline in not only the rate of automobile fatalities but the absolute number as well, even though Americans are driving significantly more miles per year. However, in 2015 the National Highway Traffic Safety Administration (NHTSA; 2016a) reported that the number of highway fatalities had increased for the first time in 50 years. Fatalities for the first half of 2016 are up over 10% when compared to the first half of 2015 (NHTSA, 2016b), indicating that this may not be a statistical anomaly. While no official cause has yet been assigned, it seems likely that increased driver distraction may be playing a role, as the proliferation of infotainment systems tied to our smart phones continues to increase.

It remains to be seen if the increase in automobile fatalities is a trend or just a blip in the data. The National Highway Traffic Safety Administration (2013) reported that 21% of drivers under the age of 19 who died in crashes did so while they were using a phone. Combine that with the fact that The Centers for Disease Control (2013) said that 69% of drivers in the United States reported using a phone while driving, driver distraction due to poorly designed infotainment systems may spell the end of the 50-year trend of decreased fatalities.

Medical systems. Perhaps the most distressing of these failures is the number of people who die in the United States each year due to preventable medical error. In 1999, the Institute of Medicine reported that every year, 98,000 people in the United States die due to preventable medical error (Kohn, Corrigan, & Donaldson, 1999). They initiated a series of plans to reduce that number by 90% in 10 years. In 2013, new estimates were published that indicated that the number of people dying each year due to preventable medical error was now closer to 400,000 (James, 2013). To put that number in perspective, that is the equivalent of six fully loaded 737-

800 airplanes crashing each and every day. If that were actually happening, we would have every single aviation human factors specialist working day and night trying to fix that problem while every one of those planes sat on the ground. From a Physician Order Entry system that doubled patient mortality rates (Han et al., 2005) to a CT scanner that allowed patients to be exposed to 10 times the safe dose of radiation (Bogdanich, 2010), it appears that as a profession we have been unable to sufficiently solve the human factors and usability issues that are contributing to these deaths.

Failure in the medical realm is more difficult to diagnose. Physician culture and complex organizational issues in the operation of hospital systems, including the procurement and use of medical devices, contribute to the difficulty in implementing universal solutions to human factors problems. Further, unlike the airline industry, where the Federal Aviation Administration has tremendous power over the airplanes and their operation (recall that they were able to completely clear the sky of all aircraft in a matter of hours on 9/11), the medical industry lacks a central authority that controls all aspects of the healthcare system. There is also a psychological factor at work: Deaths in the medical system occur one at a time in disparate places, so identifying patterns of problems is more difficult and the problems seem more isolated and disconnected.

As evidenced by the success stories cited earlier in this paper, we have concrete examples from our own profession where we have made continuous improvements to complex systems over time. Not only is continuous improvement a worthy goal, it is completely achievable. Why have we not been able to make the same strides in these areas that we have in others?

Unfortunately, there isn't a single reason why human factors and usability have had less impact in certain areas than would be desired. The problems are diverse, and many of these problems are the result of organizational and social issues that are not easily solved.

What Can We Do?

There are a number of actions that can be taken to improve our performance in these areas where progress has been slow.

- Researchers and practitioners must work more closely together. Researchers have to figure out what practitioners need in order to implement effective solutions and practitioners need to avail themselves of the ever-expanding knowledge base that could help them practice and perfect their craft. Importantly, researchers and practitioners need to agree on a method of disseminating important information so that we are all working off the same page.
- It's not enough just to have good practice. In certain circumstances, good practice may need to be codified into law. For example, one of the reasons we continue to see voting difficulties associated with usability is the fact that there are thousands of independent voting districts, each creating their own voting systems (Kortum & Byrne, 2016), a situation analogous to having every hospital in the country create their own electronic medical record system.
- We need to be better at communicating our solutions to the government, to the decision-makers, and to the general public. Years ago, I noticed that some of my colleagues, who were enormously talented, had difficulty getting the results of their research implemented. Other colleagues who were equally talented had significantly higher batting averages. Research showed that technical skill was a necessary but insufficient trait for successful human factors implementations and that people skills were one of the factors that predicted performance (Kortum & Motowidlo, 2006).
- Finally, coordinated grand challenges that bring together the most talented researchers and practitioners are needed to attack specific problems in a large-scale systematic fashion. Coupled with sufficient funding and backing from government and industrial groups, this might lead to better wide-scale solutions to these pressing problems. This may be especially effective in the medical field.

Conclusions

Although our profession has helped to improve the usability and safety of innumerable systems over the years, there are still many areas where human factors progress has been less than desired. This lack of progress is due to a number of complex issues that are not easily resolved, some of which are social and organizational in origin.

These examples should not be seen as a cry of despair; rather they should be seen as a call to action. Human factors and usability professionals must work to increase our influence by demonstrating competence in all of the core areas of the discipline and learning from the lessons of those that have gone before us. More importantly, we must become more effective advocates for our endeavors, working within and across organizations in order to ensure that human factors and usability will make positive impacts over the next 70 years.

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