GOLDEN ANNIVERSARY SPECIAL ISSUE

At the Turn of the 21st Century: Reflections on Our Science

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As the new century began, I took over as editor of the journal. By all accounts I inherited a robust journal – thanks to my predecessor. I made little adjustments on process and expanded the Editorial Board to reflect important emerging topics in human factors. The journal I "inherited" was in good shape, and I hope I left it a little better. In this paper, I reflect on the state of our science after making over 500 decisions over eight years (four as editor and four as associate editor). My reflections include issues concerning our theories, methodologies, and practice. These are offered as food for thought and in the hope that as we all reflect on the state of our science, we strive to make it better, more robust, and more relevant and that it has a greater influence on the world we live in. Time will tell.

My tenure as editor began in January 2000. By all accounts, I inherited a "well-oiled machine" from William Howell. The journal had a decent flow of manuscripts; the administrative procedures were efficient; there was a great set of thorough reviewers on the Editorial Board (EB); and most of what a good, comprehensive, applied, and scientific journal needs to operate was in place. No question about it.

But improvements (at least I hope they were) can always be made. So, administratively and structurally, I made some minor adjustments. I added more associate editors (AEs) to reflect the breadth of our field and the growth in new technical interests (e.g., aging, cognitive engineering, transportation, health care) as well as to send signals on what kinds of papers would be most welcome. I diversified the EB by adding industry and government scientists as well as practitioners. I brought on to the EB individuals from other disciplines that were closely related to our own, such as industrial/organizational, cognitive, and applied social psychologists. During my tenure, we started the electronic submission and reviewing system – a much-needed tool! This helped expedite the review process (because assignments and action letters could now be done anywhere in the world), the tracking of manuscripts, and reminders to reviewers and AEs. So, this journal was in great shape (and continues to be now), thanks to the work of my predecessors, the HFES staff, and the many AEs, EB members, and reviewers in our field. We owe a great deal of gratitude to many who have worked for more than 50 years to make this journal what it is today – the premier journal in human factors/ergonomics science.

What I would like to comment more deeply on is our science after reviewing and acting on more than 500 manuscripts over 4 years as editor and about 4 years so far as an AE. Next, I offer my own observations (and that is what they are, just observations) on the state of the science in human factors/ergonomics. They are general and intended as issues for reflection and for possible action. I offer these as food for thought and not as criticisms – as goals to (maybe) improve our science and have (it is hoped) greater visibility in matters of national and international interest over the next 50 years. I hope these serve to engage us in a dialogue (or debate) on the how, where, what, and why of improving our science – and affecting our visibility.

OBSERVATIONS

In this section, I discuss a set of observations based on 8 years of making editorial decisions. I should note, of course, that these were shaped by the authors and countless reviewers. All of the

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comments, concerns, questions, and notes I got from them have formed these observations.

1. Our diversity is our strength; our asset . . . and our weakness and liability as well.

We all know our field is very diverse – covering several disciplines and many applications. Our scientific roots come from, for example, psychology, engineering, computer science, and management systems. We focus on aviation, transportation, health care, displays, system design, aging, training, and individual differences, just to name a few (see list of topics on the back cover of the printed journal, as well as the list of HFES technical groups at http://hfes.org]). All of this is good; diversity is healthy. We can influence many settings, organizations, industries, agencies, and groups. And as an applied science, HF/E can (potentially) affect and/or influence many individuals, our society, our national interests, and beyond. Look at any issue of the journal and you will see a menu of items for diverse interested parties.

But this diversity is also a weakness – a liability. Our field belongs to many and at the same time to none. We are so broad that at times we cannot find "our soul" (noted by a colleague at an HFES Executive Council meeting in discussing the journal). We cannot define who we are, what we represent, and who we include. Our science is everywhere and nowhere, in that our science cannot be represented in a coherent way. And sometimes I wonder whether this diversity serves us well or just confuses us all. What constitutes human factors work for one is not human factors work to another. I was surprised by how many reviewers stated, "This paper does not belong in our journal." But another reviewer of the same paper would say, "This is an important topic in human factors."

Our science needs to find its essence; we need to define ourselves such that consumers of our science can go to one "window" only (if possible) and not 20 to get our "services" – a difficult challenge that has been with us for decades. And I'm not sure what the solution is, but this is something to think about and, if possible, act on.

2. Our theoretical basis is rich and solid . . . yet it could be strengthened.

Kurt Lewin said a few decades ago, "There is nothing more useful (practical) than a good theory." I could not agree more. I do believe in the need for and value of solid theories that guide our research. The good news is that our science has a plethora of well-founded and established theories. These are theories focused on human information processing, decision making, team effectiveness, stress, workload, and vigilance, just to name a few. All are good and serve us well – for the most part.

The bad news is that, in my opinion, our science is still largely atheoretical. Our applied nature seems to pull on us more, and sometimes our theories get ignored, misused, or abused. I was struck by how many articles submitted to the journal are devoid of any theoretical underpinnings. A good set of articles that I reviewed did not use, and were not driven by, clear theoretical notions about the problems at hand. So, our science, I submit, needs to be grounded in theory.

I want to be clear. I am not advocating having theory just for the sake of it. Studies need to be guided by relevant theories. Problems need to inform them, and they need to inform our problems. Also, it is not that we do not use theory; there are plenty of studies that use it appropriately and as needed. It is that more people need to use it – some need to see its value; some need to appreciate it. Not only does our science need to develop more, better, and richer theories where we do not have them for the range of human factors problems we deal with, but existing ones need to continue to be refined, validated, and/or extended. Our science could benefit from a theoretical infusion.

3. Our methodologies are robust . . . for the most part.

Because we are a diverse discipline with different perspectives, we have a wide range of methodologies at our disposal, including classic experimental design, field studies, interviews, quasi-experimentation, observation, and case studies. All, as we know, have strengths and weaknesses. We all do trade-off analysis as we decide how to conduct our studies and answer the question of interest. There are many ways to answer a particular research question, and thus we have many methodological approaches. This is well and good. I believe part of our strength as a science is our methodologies.

Having said that, I think our science could also benefit from an infusion of robust methodological approaches, especially for field, naturalistic, and complex settings – approaches that help answer in

a usable (and replicable) way the questions of interest. Similarly, most articles seem to get rejected because authors do not match questions/hypotheses to methodology. Consequently, reviewers say that the "question was not answered with the method used" (one of the most common comments I received) or the methodology applied was "weak," the findings could not be replicated (they relied on interviews and observations without protocols), and not enough information was provided about what was done and why.

So, our methods need to be strengthened, especially, as noted, for complex, "in-the-wild," cognitively based settings where some critical research goes on.

4. Our studies are relevant and on target . . . for the most part.

Our science has always strived to tackle important problems. At least I thought so, but that is not always the case. Another common reason that articles get rejected is that reviewers say, "Who cares about this issue?" "Why are the author(s) examining this problem?" "Where is the need?" This speaks to the relevance of our science. As I read reviewers' comments and the papers, I was sometimes perplexed because I did not know why the research was done. Again, who cares about it and why?

To be as current and relevant to pressing human-systems integration issues as possible, studies need to be "motivated" (i.e., provide a compelling reason why they matter). It may be that these research questions are relevant and important, but the diversity in our field requires us to make the reasons more transparent to our readers. We need to be much clearer about why the issue at hand matters and to whom it matters.

5. Our studies help with practice and design . . . but we do not translate (well).

Although human factors/ergonomics is an applied science, sometimes it seems that we HF/E practitioners forget, ignore, or do not go deep enough on the applied side. That is, our science and its findings (more often than we think) do not provide precise implications for practice or system design. Authors do not take the time to tell readers what the findings mean for practitioners, designers, or human performance managers and/or what they say about design or for interventions (or even what these are). This is what I call the *translation problem.* We are not good at translating scientific findings into recommendations, guidelines, tips, or prescriptions. As much as I pushed authors, they were resistant to the problem or apathetic or lacked know-how (of course, some are good at this). I did not understand this.

So our challenge is to translate our findings into practical terms. And as long as these are rooted in science, I do not have a problem with such translation and, in fact, would like to encourage it. Our science can benefit (I think) and have more impact only if we take the time to translate with precision what we find in our studies. A whole new world may open to us, or the world that is knowledgeable about HF/E science will see our practitioners in a different (and useful) light. So, let's translate what we find in our research, where there is enough evidence to support it, and communicate our findings in a precise, practical, and understandable way. We need to start thinking about evidence-based human factors/ergonomics practice that is, of course, rooted in solid science.

CONCLUDING REMARKS

At the turn of the 21st century, the science of human factors/ergonomics is well positioned to affect society, improve the quality of lives worldwide, and enhance human performance and minimize costly human errors. I am optimistic. We have the theories, methods, tools, and focus to do so. Of course, challenges remain. But I believe our scientists and practitioners are up to it. Keeping our human-centered focus is an imperative. Keeping (and improving) our theories, robust methods, and tools is a must. Keeping an eye on real and significant problems will take us far. And translating our findings will gain our science respect, prestige, and importance. The opportunities are ahead for us.

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Date received: November 5, 2007
Date accepted: March 3, 2008