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The Future of Aviation Research

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It goes without saying that I certainly don't have a crystal ball, but I think it would be informative (and perhaps useful?) to examine where we are currently in aviation research, and maybe where we might want to be in the next five years. I don't pretend to have special qualifications in that regard (predicting future developments), but I have worked in aviation human factors for nearly 40 years and hopefully I've learned something along the way that might be of use to students, researchers, and even journal editors. Just a quick note on my background: I retired from the Navy as an Aerospace Experimental Psychologist (AEP), and subsequently worked for small business, and currently academia (the latter for the past 18 years). So I consider myself fairly well acquainted with various entities that conduct research in aviation or at least promulgate its impact. Please note that the following comments are reflections resulting from my experience in the field, and thus opinion-based. I have not consulted peer-reviewed sources to support my contentions, but my intention here is to perhaps stimulate dialog and examine my experiences and those of others working in the field of aviation research.

First, I'm impressed with the amount of research ongoing in aviation. When I first started conducting my research in aviation, the two main sources we would consult for possible publication were Human Factors and the International Journal of Aviation Psychology, two well-recognized journals in mainstream human factors. Now it seems there are numerous journals devoted to either human factors and/or aviation safety. The increased growth in publications is partly due to the fairly recent introduction of online journal publications. There was a time when few of us would ever consider publishing our research online given its stigma as being less rigorous, but that attitude has certainly changed over the years. Both have peer reviews, and the

quality of publications between these two forums has become almost indistinguishable. No longer is it considered inferior research if it is published in an online journal. Most of us would agree that receiving a one or at most two month notice as to acceptance or rejection of an article in an online journal is far better than the standard six month wait that most of us have experienced in printed journals. Another new feature of today's aviation research is the advent of using online subject pools like MTurk. We can now gather data from literally hundreds of participants in as little as one or two days. Of course, there are limitations to this technology, but it is a feature that those receiving graduate degrees from online university programs can take advantage of given the lack of suitable laboratory facilities that one would have available if attending an online university. A potential limitation here with so many forums in which to publish research is the resulting competition from editors to attract more interest in their specific journal. I would guess editors are finding it quite challenging to publish research investigations in their respective journals when there is so much competition from other sources. One would hope that in the process of doing this, that the criteria for accepting submitted research will not degrade over time. Quality over quantity should be what we strive for.

While there is no doubt an increase in the amount of aviation research being conducted, it could be argued that some of this increase is due to researchers maintaining a line of research that is generally the same from year to year; few new topics are being introduced or investigated. Tweaking a variable here or there seems to be quite common as anyone can observe when attending most major human factors conferences today. Many researchers have been involved in the same area for years. When I attend an aviation conference I know beforehand what I will hear, and who will be doing what. No surprises. Sorry, but this makes for one boring conference in my opinion. My experience (and remember this is opinion-based) is that some of the excitement from the past is missing, due mainly to the lack of new areas of research. One only has to go back a few years to the initial research on vigilance, for example, or even situation awareness to see few new theoretical developments today coming out of current research. But we see this in psychology as well, so aviation/human factors is not unique in this regard.

Second, and this pertains to many academic programs in aviation, there seems to be an increase in acknowledging that we need to be more rigorous in educating graduate students in methodological approaches to research, and more specifically, statistical analysis (both quantitative AND qualitative). It's not unusual for graduate students terminating at the masters level to only have completed one statistics course, and that will most likely be a quantitative class. I have only seen a few graduate students who have any background in qualitative analysis. In fact, there seems to be the mindset among students that qualitative analysis is "easier" than quantitative. This couldn't be further from the truth. Many view qualitative research as less rigorous and more in line with common sense outcomes. Qualitative research, or perhaps even mixed method studies, could add another dimension to the research we are seeing today in aviation. It's finally come into its own, and more and more graduate program are now offering qualitative analysis courses. Such research employing qualitative methods may lose some objectivity, but I'm not sure if that's even an accurate assessment. After all, much of quantitative research is based on the participant's subjective responses, so what we evaluate as "objective" may not really be so. Assigning values to a Likert scale doesn't make it any more objective; it's still based on subjective opinion. In any case, it's encouraging to see the kind of rich data we can accumulate by asking participants to comment upon their experiences and

reflections while engaged in human factors aviation investigations. Psychology in general has accepted the viewpoint that qualitative research is as valid as quantitative; however, I think aviation research is a bit behind in recognizing the value of qualitative data.

Third, and this may seem somewhat contradictory to what I just said, but when conducting quantitative research more attention needs to be focused on basic design development. I can't tell you how many times I've had to tell students, "The research questions drive the study's approach." I actually have students come see me with the methodology they want to employ in a study prior to even constructing their research questions. I think this is partly the result of some students feeling more comfortable with a qualitative or quantitative study and go into it thinking they need to shape the study to fit into one or the other methodologies. The other common question I get is "How many participants should I get for my study?" Some have never heard of power analysis, let alone conducting an a priori power analysis and then the follow up post hoc power analysis. Not sure I'm even seeing power analysis used in many of our journals today, let alone a post hoc power analysis. Unfortunately, I'm still seeing aviation studies conducted with N = 10 participants. What's even more amazing is how often the researcher attempts to conduct traditional statistical analysis with small N. Gaining any kind of statistical significance with small N studies as this makes me a bit skeptical. I'll leave it at that.

Given the status of aviation research today, what changes/recommendations should be forthcoming that might accelerate both the growth of aviation research as well as the quality. Here are a few recommendations:

1. An emphasis should be placed on the proper conduct of a research investigation. This would include additional coursework in research methodologies, experimental design, and statistical analysis for students. Graduate students should be required to complete a basic and advanced course in statistical analysis. A third course should involve qualitative analysis techniques/methods.

2. Teaching aviation/human factors courses is certainly important. But often new faculty are hired based on their past work experience in the field, and less so on their publication or research record. The latter may be non-existent in some cases. Traditionally, those faculty hired in many aviation programs have stellar work credentials, but little to no research experience. It's not unusual for many aviation departments to have the majority of faculty focused on teaching only, and a few faculty carry the load insofar as conducting their own research programs, or at a minimum, assisting graduate students in conducting thesis/dissertation research. We need faculty who both teach and mentor graduate students in completing thesis/dissertation research. It is my belief that candidates who are most amenable to teaching and research are those who are recent doctoral graduates or those coming from small businesses who have survived as a result of their track record in successfully competing in grant development and producing applied solutions to problems. I worked in small business prior to coming to academia. It's extremely competitive; you need to know your stuff to survive the grant process.

3. It is my belief that in order to mentor graduate students in conducting research, the faculty member needs to have a proven track record in conducting his/her own research. These considerations should be, of course, priorities at hiring, but also incentives should be offered to those faculty who wish to participate in research endeavors. More thought should be given to offering class reductions (many universities require faculty to teach 4 or 5 courses; difficult if not impossible to pursue research opportunities with such course loads).

4. Most administrators at universities will no doubt put priority on funded research since the percentage of funding that goes directly to the university is typically quite high; (50% overhead is not unusual). One solution is to offer a consulting opportunity run directly out of a specially-designated department within the university. Many faculty are faced with the choice of conducting research through their university's sponsored programs department (and losing about half of their funding), or conducting the research outside the university as a consultant. The latter requires the researcher to work without any administrative support from the university. One solution to attract more university sponsored research is to establish a consulting unit within the university. For example, Florida Tech has FIT Consulting; a unit that will assist the faculty researcher in completing budgets, paperwork, etc. while requiring a significantly reduced overhead rate. This is a win-win situation. The researcher gets more money in his/her pocket, and the university doesn't miss out on an opportunity.

5. Closer ties with small business is important. One of my last grants was a STTR (Small Business Technology Transfer) which is a government funded program that requires a small business to take the lead but pair up with a university as a subcontractor. By forging these closer relationships with local small businesses one opens up another avenue for funded research, and you can leverage the skills of both academia and business enterprises.

The challenge for aviation researchers is to both upgrade the knowledge of students enrolled in aviation programs (more stats, more methodology courses), and continue enhancing the skills of those who are mentoring our students. We have to demonstrate our value, and the value of the research we conduct. Our research should have some application that will improve upon some existing system or platform. Forming alliances with small business (the latter of which typically conducts applied research in order to garner funded contracts) or other entities increases the probability that one will obtain the necessary funding to pursue a line of research. Laboratory studies are fine; but will the outcome of such research get the attention of the research community, or is it merely an exercise that will lead outsiders to perceive what we do as "common sense" (I hear this all the time from so-called "human factors" experts who assume they have such knowledge because they worked in the aviation industry). We need to distinguish ourselves as having specific skills that will benefit society. If we can't do this then whatever we do will be lost and forgotten in time with the general perception that anyone can do aviation research/human factors. We lose our uniqueness in the process. And with that a reduction in research opportunities.