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AVIATION PSYCHOLOGY RESEARCH - EXTENDING SCIENTIFIC METHOD TO INCORPORATE VALUE AND APPLICATION

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Showing value (i.e., useful, needed, solves a problem, adds to knowledge) in the research process and its products is intended to enhance the quality of psychological research. The additional research information (META Data - The information that describes and clarifies other data) will enhance the design of the research project and will aid research customers determine the value of research results and provide guidance in its application. The intent is to support and complement the Scientific Method and its associated rules of implementation, while providing clear and easily used value and applications data.

For as long as there has been research, there has been a debate about the need to keep it separate from business interests. Many scientists contend that research must be kept separate because business focuses on supporting a product and service development and is not concerned about the “true purpose,” which is the development of scientific knowledge. Many researchers believe:

“If you’re a scientist because you want to advance knowledge then the embedding of science in capitalism feels like a poor fit. . . . There is no reason to think that the invisible hand of the market will steer us exactly the same way that well funded scientists would. There’s no guarantee that any particular area of knowledge will have monetary value now or ever, directly or indirectly. We don’t know and can’t know exactly what will turn out to be of extraordinary explanatory or practical value. If science were left solely at the mercy of capitalism, it would be indistinguishable from product development. . . . The fact is that demands of capitalism and the processes by which we develop ideas and knowledge don’t always fit together well. Businesses too, would do well to keep them apart except where there aims are truly aligned.” (Weinberger, 2007).

In this paper, I will present an approach that will enhance scientific knowledge while providing research results that are valuable to business, industry, publishers, and other capitalist enterprises. In a nutshell, the approach will only require researchers to understand their research topic environment, document it, process META Data, and

present this META Data with the research results to both the research and business communities.

Introduction

I have previously presented the concept that the psychology, human factors, and ergonomic professions have a lot to gain by improving their perceived and real value to their customers (Gallaway, 2006, 2007). I believe that if we can show value for our profession we can also show more value in our research. I am not alone in my thinking. The need for and importance of showing the value of research has been espoused in numerous books published throughout history (AMA book, 1961 is a good example). This paper provides an approach that complements the dissemination of research results by including additional information (META Data) that research customers can use to identify the value of the research results and identify information that will help them apply the results. Since it is sometimes easier to understand an idea through example, I provide four to illustrate different views of the need for value and application information.

1. A few years ago I attended a meeting where researchers reviewed their current work projects and discussed their projected future work. Many of the attendees were experienced researchers used to identifying important research topics in their subject areas. They typically obtained research funding by submitting proposals to funding organization, which determined worth and provided grants to deserving projects (obviously a simplified description of the process). But, researchers at this meeting indicated that this process might be changing. In particular, one researcher requested guidance from his peers

because his funding process had already changed. He explained that his managers now wanted him to show the value of his research for customers and indicate how his research results could be applied before they would fund new projects. The person had no idea how to deal with this mandate. He explained that his training had not helped him develop the necessary skills to do this.

2. A number of discussions during the 2006 IEA World Congress centered on how to show value for research products. Participants worried that if they could not show the economic value of their work, their future employment as researchers would be at risk. These scientists understood the academic requirement for publish or perish. But, now research sponsors wanted them to develop a useable, valuable, product in addition to creating scientific knowledge. It was no longer sufficient to publish esoteric research pieces in little read journals.

3. A person who manages research for their company (oversees research in their in-house laboratories in the U.S., Germany, India, and Mexico) pointed out that his company seldom used academic research resources. He explained that, from his perspective, individual researchers often did not have a broad understanding of their subject area, and, hence, could not show how their research findings could help meet company needs. In addition, his company needed to relate research to value, schedule, customer needs, product requirements, and other issues that the academic researcher did not address.

4. Many years ago an organization did a study evaluating how often scientists and engineers actually used their professional journals. The study tried to include all known journals being published in all fields at that time, which included over 3,000 journals worldwide. My recollection is that their analysis indicated that each article in all those journals was read about 1-½ times and one of those readings included the authors. The study attributed this low readership to the difficulty of extracting value from the research papers. Since no significant change has been made recently to the value extraction process, it is not expected that readership averages have increased substantially. Even if my recollections are off by an order of magnitude, it seems clear that we have not been very successful in providing others with real and usable research value.

These examples illustrate the need to not only produce scientific knowledge, but also to find a way to identify the value of our research so we can show customers how our work can help them in a practical and cost effective way. Before proceeding with a search for a solution to the problem, I want to

examine if historically there has been a conflict between the research goal of producing scientific knowledge and the business need for value.

History of Research Process

I am curious if the historical foundations of research argued for maintaining the PURITY of science research and limiting research to creating scientific knowledge. History indicates that research is intended to increase knowledge for all purposes. Increasing knowledge for commercial benefit was never excluded. I find no evidence that the only purpose of research was to produce scientific knowledge alone. The following quotes from early descriptions of psychological research will help explain the intent of research:

"The Scientific Method - along with exposition, logic, and mathematics – may be regarded as an extension and refinement of everyday thinking. All of these disciplines are concerned, not with facts, but with ways of dealing with facts; and books in these areas are all in a sense “how to” books on thinking. From this point of view, the present volume is a book about the improvement of one’s day-to-day method of acquiring knowledge about the world - as well as a book about a particular method for acquiring knowledge about the world which has been developed over several centuries by some of history’s finest minds, and which has proved to be singularly effective". (Anderson 1966).

This quote indicates the original intent of the Scientific Method in research was to deal effectively with facts. Although the early writings are often silent about describing research results in a way that discussed value and described application, such attributes are not necessarily excluded as components of research. I found the early authors equally silent on the need to do research only to create scientific knowledge. Let me illustrate this with a couple of additional quotes.

“There are six rules which, taken together, seem to characterize the Scientific Method uniquely and thus distinguish it from other approaches to understanding the world. The Scientific Method is here defined as the following set of rules for describing and explaining phenomena: Operational Definition; Generality; Controlled Observation; Repeated Observations; Confirmation; and Consistency.” (Anderson 1966).

These goals or requirements for the Scientific Method and their supporting infrastructural rules

(sample size, statistical significance, etc.) in no way limit our dealing with value and application.

“The experimental psychologist, so it always seemed to me, needs historical sophistication within his own sphere of expertness. Without such knowledge he sees the present in distorted perspective, he mistakes old facts and old views for new, and he remains unable to evaluate the significance of new movements and methods. In this matter, I can hardly state my faith too strongly. A psychological sophistication that contains no component of historical orientation seems to me to be no sophistication at all.” (E. G. Boring, from the introduction of his *A History of Experimental Psychology*, quoted in Misiak, 1961).

This statement indicates the need for researchers to know their topic thoroughly and to know the environment of the area they are going to research. Current research process always expects a researcher to do a literature search that describes past work but does not emphasize a thorough grounding in the real world of the research area. This point will be one component of the proposed improvement.

These three quotes from early implementers of the Scientific Method in psychological research point out the intent of research and the method needed to do the best job possible to produce valid knowledge about a topic. Their emphasis on a process of “Dealing with Facts” in a clear manner suggests to me that including requirements in our research to show value and aid in the use of research results is completely in character with the intent of research and the Scientific Method.

The Problem

Given my conclusions that the intent of scientific psychological research has always been to provide valid answers about a topic as well as information about value and application, what is it about our current research process that tends to exclude value and application information?

Become Knowledgeable about Research Topic

Valid research is dependant on a comprehensive understanding of the issue, its environment, most of the variables that affect the issue, and how the issue is affected by them. Based on these requirements, we can surmise that the more knowledgeable a researcher is about the topic, the better focused the research can be. I believe that many academic researches are at a disadvantage because they often do not have the access to, time, or resources to

thoroughly learn about their particular topic, i.e., understand it within a larger, worldly context. This process often perpetuates basing new research on old research instead of researching real world conditions and issues.

Record Research Topic Meta Data

As researchers develop a research plan, they consider a large number of parameters, conditions, and purposes. When it comes to documenting all of the factors that affect their research topic, most of us only record a limited set of data. The factors that are lost could be useful once the research is complete to help us understand better the results value and where and how to apply the results.

Record Research Results Meta Data

The current psychological research process does not emphasize identifying and recording the META Data associated with research results. This META Data would help research customers identify value in research results and have information that would aid applying the results.

Revise Reporting Process

Even if we collected the information that would show value and indicate how to apply the results, we often face procedural, administrative, and reporting constraints in the current research process that make it difficult to provide value information. To overcome these constraints, I suggest we adopt a number of new processes.

- a. We need to develop a common, standardized documentation method to ensure that users of research results would have access to our Meta Data.
- b. Researchers who know they are going to publication/present must see the value in creating META Data. Refereed publications should require information on real world application of published research information. Requiring the value and application META Data would require rethinking paper content on the part of the publishers and conference organizers.

Human Subject Data Is Needed

Doing research using human subjects is always a challenge to the validity of research. Often subjects are selected by availability and cost instead of appropriateness. This makes interpreting the results more of a challenge. Human subject META data collection could substantially improve the understanding of subject selection on the research.

Results Integration with Other Information

Individual research findings must often be combined with other concepts and data as it is being integrated into products and systems. For this process to be effective, a great deal of research topic/results META Data is needed. The types of data needed for this task can be anticipated and planned for in the initial stages of research.

Value in Reduced Scientific Method Adherence

Industrial-based research includes traditional academic research and assessments of value and application. This approach might suggest a viable approach for psychological research. My first 17 years of employment was in a company that performed basic and applied research, and implemented our research results. Hence, I am familiar with research approaches that require that value and implementation strategies be identified.

Accept Less Than Pure Scientific Results

Some researchers believe that their work is only valid if it follows and completes all the tenants of the Scientific Method, including scientific rules of completion (such as statistical confidence, and sample size). In much research, only portions of the method can be applied, and, from a practical standpoint, this should be acceptable because it provides better results than no consideration of issues identified by the research process.

In the company I worked for, we identified research topics based on products that we thought would be needed in 3-5 years. Our team designed the research so that the results could be used by follow-on researchers and product developers could use the results to support future product designs and service processes. [VALUE/APPLICATION FACTORS: We did follow the Scientific Method and all other applicable psychological research guidance. To ensure future utility of our research, we provided all the information needed by follow on activities, which included META data documentation and information.]

Our work always included a comprehensive study of all aspects of the topic that helped us to focus our research on high return on investment (ROI) topics. [VALUE/APPLICATION FACTORS: Know the topic and its environment inside and out before designing research in it. Document the environment.] Because of practical limitations (time, money, resource limitations), we often could not use the total number of test subjects required by strict science statistical significance. We compensated for this by

using subjects that worked in the research topic area and testing them in a real work environment. This approach usually provided better results than adhering to strict research rules. [VALUE / APPLICATION FACTORS: Employ as much of the Scientific Method as is practical and compensate for shortfalls. Limited research is often better than guessing. Research/test in as close to real world conditions will compensate for scientific shortfalls. Remember that laboratory research is often its own shortfall because of its artificial environment and operating conditions.]

Statistically significant research results may have no value when applied in a real world task or environment (an example: Research that showed that one task was 1 second faster than another [statistically significant], but in the real world it didn't make any difference because the task was embedded in a process that took 20 minutes to complete). Conversely, not showing significant differences may not be a reason for not using research results when applied in a real world situation. [VALUE/APPLICATION FACTORS: Research results need to be evaluated in conjunction with its META Data and the potential application.]

Conclusion and Proposed Solution

This review of the need for, historical foundations of, and benefits of helping customers easily assess the value and application potential of our research results indicate that improvements can and should be made. The historical underpinnings suggest that there was never any intent to see research solely as a generator of pure scientific knowledge to the exclusion of providing a product that could be used in a commercial enterprise.

Further examination shows that the Scientific Method is weak in requiring the researcher to describe clearly the research project topic environment and the research results (the META Data). The Method also tends to advocate limiting a researcher's knowledge about the research topic environment (understandably for independent/dependant variable control), which may be a hindrance to designing meaningful, effective research.

It would be impractical to think that we could change the Scientific Method even if it needed change. But, I would argue, it is in our power to enhance it so our research will produce excellent results that can be used in the real world. I would like to suggest that we supplement our research process with the information needed to make our research and research product more valuable to us and our customers.

I have an aversion to saying, “we should do this or that” without providing an initial path to accomplishment. Therefore, in the next section of the paper, I want to propose a proposed solution that outlines two main enhancements to our research process. The example VALUE and APPLICATION table attached at the end of the paper demonstrates the proposed solution.

The two enhancements to be addressed are:

1. Increase knowledge of research area, people, breath, constraints, problems, environment, etc., so that the researcher will be able to better focus the research on real world areas that need new knowledge. (NOTE: The sample VALUE Table will only show the META data results of better evaluation.)
2. Identify and record all pertinent information about the premises of each research project, provide a broader description of results in terms of the problem being addressed, the limitations, advantages, etc., that will help customers assess value and guide their use of the results.

Value and Application Table Proposal

I am proposing an implementation strategy for enhancing research projects and their results. This will be accomplished by paying attention to the information needed by research customers to identify value and aid them in their application of the research findings. My proposal advocates a continuous improvement approach that employs research to determine scientifically the most effective content, presentation, and deployment as applied to psychological research.

Objectives

1. Establish META Data requirements that comprehensively describe and record the problem the proposed research is trying to solve. This META Data should enhance the quality of the research design and process and be used to guide application of results.
2. Maintain the Scientific Method and associated application rules and processes as the basis of research, while providing the expanded information (META Data) that enhances research results use. Modify the research results reporting process to require that the META Data be included so that customers of the research results will be able to identify value and have information needed for its application.

3. Develop a means to record and distribute research results that have the potential of providing value to customers but do not meet all the tenants of the Scientific Method and associated rules.

4. Researchers, academic institutions, industry, and customers of research work together to research and define the what, when, where, and how the META Data that will be applied to all research findings.

Actions

1. Determine through research the type of META Data needed to show value and aid application.
2. Determine through research how the researcher can better understand and record the research topic environment to better define the research project. Since the researcher may not be able to do in depth background characterization for a research project, they should explore how they can tape the knowledge of people/experts in the targeted environment.
3. Develop a paper and electronic value/application reporting document component (and supporting preparation guide) that can be provided with all research project results.
4. Request that publishers and conference publications ask researchers to use the value/application reporting document component with each of their research papers on a volunteer basis.
5. Test the value of the value/application concept and continuously improve.
6. Develop simple paper- and digital-based educational material and tools that can be used to help ensure that needed value and application data is collected, applied in research design, and reported.
7. Market this enhanced research approach to all customers (this is an opportunity for publishers to increase their value too).

Benefits to Those Associated with Research

1. Users of Research Information: Quickly identify research findings that apply to their needs and understand the parameters of where it came from and where it can be applied.
2. Researchers: More valid, valuable, accurate, knowledgeable research results. A much larger percentage of their research findings will be used to create additional value.

3. Research Publishers and Conference Pubs: Publications would be an important source to find valuable research results.
4. Industry / Business / Government: These organizations will be able to easily find, understand, and apply all types of research results. They, in turn, will be more supportive (fund) of research organizations because they can see value.
5. Academic Institutions: The ability to show value for their sponsored research will increase their funding and support for students/professors.
6. Professional Organizations: Most professional organizations are charged with promoting the value of their discipline and professionals. Showing value for their research work would be a great benefit to these organizations.
7. Society: Research will deliver a substantial increase in value for the resources expended. It will also provide needed knowledge that often was overlooked in the past because it was not effectively articulated and presented in a practical way.

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Example VALUE AND APPLICATION TABLE FOR PSYCHOLOGICAL RESEARCH

RESEARCH PROJECT META DATA Select and insert description provided in the META Data guidance document.				
Research Topic Describe the research topic.				
Project: _____				
Problem/Issue to be Researched: _____				
Purpose: _____				
Number of task steps in Real World: <input type="checkbox"/> Task(s): _____				
Research Represents: Full Task <input type="checkbox"/> Part of Task <input type="checkbox"/> Alternative <input type="checkbox"/> - Explain: _____				
Topic Environment: Describe topic environment & how it was evaluated in prep. for establishing research requirements.				
Location: _____		Knowledge Of Topic Obtained By: Site Analysis: <input type="checkbox"/> Subject Matter Expert: <input type="checkbox"/> Survey/Questionnaire: <input type="checkbox"/> Literature Search: <input type="checkbox"/> Not Linked to Current Environ.: <input type="checkbox"/>		
Physical Environment: _____				
Individual/Group Activities: _____				
Tasks: _____		Type of Research Site Test: <input type="checkbox"/> Laboratory Test: <input type="checkbox"/> Survey/Questionnaire: <input type="checkbox"/> Compilation: <input type="checkbox"/>		
Equipment: _____				
Economics: _____				
Problems: _____				
Performance Issues: _____				
People In Topic Indicate skills, education, tasks, age and other parameters that describe the people.				
All people who impact the topic & how: _____				
People research will represent & how: _____				
Research People Subjects Represent in Topic Environment: _____				
Real World Workers: _____				
Volunteer/Hired Other: _____				
College Student Subjects: _____				
Research Results Meta				
Research Completion Date: _____ Language: _____		Human Attribute Cognitive: <input type="checkbox"/> Physical: <input type="checkbox"/> Process: <input type="checkbox"/>	Impacts Safety: <input type="checkbox"/> Ease of Use: <input type="checkbox"/> Process/Task: <input type="checkbox"/> Acceptance: <input type="checkbox"/> Speed/Errors: <input type="checkbox"/>	Measure Speed: <input type="checkbox"/> Errors: <input type="checkbox"/> Completions: <input type="checkbox"/> Recall: <input type="checkbox"/> Other: _____
Independent Variables in Research: _____				
Independent Variables not Researched: _____				
Dependant Variables in Research: _____				
Dependant Variables Not Researched: _____				
Results: _____				
Results Value: _____				
How Results Can be Used: _____				
Limitations: _____				
Conditions: _____				
Documentation: Obtain From:				
Research Report: _____		_____		
Publication: _____		_____		
Presentation: _____		_____		
Research		Researchers Full		
Name: _____		_____		
Address: _____		_____		
City: _____ State/Province: _____		_____		
Postal Code: _____ Country: _____		_____		
Phone: _____ Website: _____		_____		