



Theory versus practice in the human factors and ergonomics discipline: Trends in journal publications from 1960 to 2010



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ABSTRACT

The research-practice gap has been highlighted as a barrier to effective practice in human factors and ergonomics (HFE). There is also evidence of a theory-research gap that may be limiting the scientific evidence base of HFE. The purpose of this study was to examine trends in journal publications, especially relating to the research-practice gap and the involvement of theory over time. A content analysis was conducted on 425 journal articles published in *Human Factors*, *Ergonomics*, and *Applied Ergonomics* from 1960 to 2010. Results showed evidence of growth in applied research with increasing collaborative research between research and industry, larger research teams, and more empirical research—especially on applied problems. While there has been a corresponding increase in the involvement of theory in HFE publications, around half of the publications failed to acknowledge theory. This calls into question whether the HFE discipline may be missing the benefits of theory to guide research and subsequent practice, and to enhance the development of new ideas.

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1. Introduction

Human factors and ergonomics (HFE) is defined as “the scientific discipline concerned with the understanding of the interactions among humans and other elements of a system and the profession that applies theoretical principles, data and methods to design in order to optimize well-being and overall performance” (IEA, 2000). HFE aims to enhance the effectiveness and efficiency of work and other activities, and to enhance desirable human values such as improved safety, reduced fatigue and stress, and improved quality of life (Sanders and McCormick, 1993). To achieve these outcomes, many scholars have argued that there must be a transfer of knowledge and synergy between the research and the practice of HFE (Caple, 2008; Meister, 1999; Salas, 2008; Sind-Prunier, 1996; Singleton, 1994). However, discussions in the HFE literature in the past 50 years have indicated a breakdown in the relationship between research and practice, which may be threatening the usefulness of research and the effectiveness of practice in the HFE discipline.

Similarly, in other applied scientific disciplines such as

industrial, work, and organisational (IWO) psychology, library and information science, and nursing and allied health, there has been much discussion about whether practitioners are implementing research findings, and whether researchers are addressing questions relevant to practitioners (Cascio and Aguinis, 2008; McNicol, 2004). There is concern that while academics continue to invest heavily on producing research, practitioners do not read or place a high value on research (Brown and Spencer, 2004; McNicol, 2004; Rynes, 2007; Rynes et al., 2002). Thus the common question across many scientific disciplines is whether practice is benefitting from research (Gelade, 2006; Le May et al., 1998; McNicol, 2004). This phenomenon has been identified as a ‘research-practice gap’ and can be defined as the integration of research into practice (Chung et al., 2016). While other scientific disciplines have extensive empirical literature on the research-practice gap, there has been relatively little empirical research in HFE on this issue.

In recent years, a series of studies have investigated the nature and extent of the research-practice gap in HFE. Chung and Shorrock (2011) conducted an international survey on the perceptions of HFE professionals about a research-practice gap in HFE. This study showed low awareness of published research since 50% or more respondents had not read most of the IEA-endorsed journals and a similar percentage could not name HFE or related scientific journals that are useful to them. The results suggest that access to research

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(‘I am unaware of the research’, ‘the relevant research is not compiled in one place’, ‘I do not have time to read research’, and ‘journal articles are not readily accessible’), and applicability of research (‘implications for practice are not made clear in research articles’ and ‘the research is not relevant to my practice’) may be the most important causes of the research–practice gap in HFE.

There is considerable support for the lack of access problem, as practitioners are less likely to have access to library databases (e.g. Web of Science, Scopus) used routinely in academia and practitioners who are not Society members may have little access to journal articles unless they pay for a personal subscription, which tend to be costly. The sheer volume of research may also be a problem. [Chapanis \(1967, p. 9\)](#) argued that “one of the most difficult tasks for the ergonomist or human factors engineer is to find and identify that very small percentage of information that will really contribute to the solution of whatever problem he may have at hand”. [Corlett \(1992\)](#) and [Wilson \(2000\)](#) also noted the increasing size and number of journals.

Similarly, the issue of applicability resonates with comments in the HFE literature concerning relevance and generalisability. [Chapanis \(1967, 1988\)](#) pointed out that the applicability of journal articles might be questioned because the research methods may be seen by practitioners to be removed from the real world (e.g. laboratory experiments, using university students as participants), or the factors controlled for the sake of experimental design may be of greater relevance to the performance of real-world jobs than the variables being manipulated. Others argue that research may only deal with small parts of large, complex systems that interact with other factors in the environment, which practitioners may perceive as having little practical significance and limited generalisability ([Meister, 1999](#); [Wilson, 2000](#)). [Salas \(2008, p. 353\)](#), in his role of editor of the *Human Factors* journal, also highlighted the ‘translation problem’ in making the reports of research applicable to practitioners, and observed that authors often did not provide precise implications for practice or system design. The theme of access and applicability of research also came through strongly in the suggestions given by HFE professionals in the [Chung and Shorrock \(2011\)](#) survey to bridge the research–practice gap. The most frequent suggestions were to increase collaboration, communication, and networking between researchers and practitioners; for researchers to ensure the applicability of research; and for practitioners to increase the utilisation of research.

The research on the research–practice gap was extended to investigate journal article attributes by researchers and practitioners in HFE compared to researchers from a related discipline, Psychology ([Chung et al., 2014](#)). This international survey found that both HFE researchers and practitioners value practical significance of journal articles more than theoretical significance or the development of theories and models, whereas Psychology researchers value theory much more highly than practice-related attributes. HFE researchers and practitioners also made similar choices when selecting journal articles. These results were surprising given the ongoing commentaries over the years about the divide between researchers and practitioners in HFE as they suggest that researchers and practitioners in HFE are, in fact, very similar in what they value about research and what they choose to read. This suggests that the research–practice gap may not be as large as previously expected. Perhaps more importantly, the comparison with Psychology researchers suggests that the HFE discipline may be neglecting theory development and that there may be a theory–research gap.

Several scholars in HFE have discussed the importance of theory to the discipline. For example, [Meister \(1999\)](#) argued that the relationship between theory, research, and practice can be divided into three parts: 1) the relationship between theory and research,

and the assumption that theory should direct research; 2) the relationship between research and practice, and the assumption that research should provide guidelines for design and operation; and 3) the inter-relationship between all three. The assumption is that if theory—a defining characteristic of science—is lacking, then research cannot supply the guidelines that should direct practice ([Meister, 1999](#)). Others have also highlighted a role for theory in HFE. [Getty \(1995\)](#) emphasised the need for the principles of ergonomics to be based on sound and validated research, and that the proper science and practice of ergonomics has long-term implications for the future of the discipline. [Karwowski \(2005\)](#) took the role of theory further and identified three main paradigms for the HFE discipline: 1) ergonomics theory, which is concerned with the ability to identify, describe, and evaluate human–system interactions; 2) ergonomics abstraction, which is concerned with the ability to use those interactions to make predictions that can be compared with the real world; and 3) ergonomics design, which is concerned with the ability to implement knowledge about those interactions and use them to develop systems that satisfy consumer needs and relevant human compatibility requirements.

Despite considerable agreement on the importance of theory, some scholars have commented that theory has been lacking in research published in HFE journals. For example, in his reflection on the eight years of being the editor of *Human Factors*,¹ [Salas \(2008, p. 352\)](#) commented on the need for solid theories to guide HFE research, and advocated that HFE as a science “needs to develop more, better, and richer theories where we do not have them for the range of human factors problems we deal with” as well as refining, validating, and extending existing theories. However, he was struck by the observation over the years that many articles submitted to the journal were “devoid of any theoretical underpinnings” ([Salas, 2008, p. 352](#)). [Corlett \(1992, p. xxv\)](#) also commented that HFE is a science-based discipline and the effectiveness of the HFE practice is heavily dependent on the reliability of the scientific underpinning, but “much of the scientific ground on which we stand is still very thin”. Similarly, [Salas \(2008\)](#) stated that although HFE has many well-founded and established theories focused on areas such as human information processing, decision-making, team effectiveness, stress, workload, and vigilance, the HFE science is still largely atheoretical. Some scholars have also pointed out the negative consequences of neglecting theory in research. For example, [Salas \(2008\)](#) stated that if HFE professionals pursue only an applied focus, this would result in theories becoming “ignored, misused, or abused” ([Salas, 2008, p. 352](#)), and [Hockey \(2008\)](#) argued that a neglect of the theoretical foundations may compromise effective application.

There is clearly a need to further investigate not just evidence of the research–practice gap in HFE, but also evidence for a theory–research gap or the integration of theory into HFE research. Some answers may come from studies of the characteristics of research published in the HFE discipline. Journal publications are an important form of communication in any discipline as they transmit new ideas and should reflect current thinking and practice in the discipline. In HFE, two major content analysis studies of publications have been conducted previously. In the US, [Meister \(1999\)](#) conducted a content analysis of 621 empirical and non-empirical papers published in *Human Factors* and the Annual Meetings of the Human Factors and Ergonomics Society (HFES) sampling across the years from 1965 to 1995. In the UK, [Waterson and Sell \(2006\)](#) conducted a content analysis of all papers published in *Ergonomics* from 1957 to 1999. These studies revealed that over the

¹ Eduardo Salas was the editor of *Human Factors* from 2000 to 2004, and associate editor from 2004 to 2008.

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