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Review article

Temporal variability in human performance: A systematic literature review

Kevin S. Muhs [a, *], Waldemar Karwowski [a], Dave Kern [b]

[a] Industrial Engineering and Management Systems, University of Central Florida, Orlando, FL, USA
[b] Kern Technology Group, LLC, Virginia Beach, VA, USA

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ABSTRACT

Objective: The objective of this paper is to conduct a systematic literature review on the evolution and current status of research into temporal variation impacts on human task performance.
Methods: This review details the findings from a systematic review of peer reviewed literature identified via keyword searches in ISI Web of Science, Engineering Village Compendex, IEEE Explore, PsycINFO, Defense Technical Information Center (DTIC) online, ProQuest Dissertations & Theses, and Google Scholar. Proceeding articles, peer reviewed journals, cited grey literature, and government technical reports relevant to temporal variability in human performance were identified and used in this review. Both statistical and contents analysis were conducted in this paper.
Results: Results suggest that the current state of research in human temporal variability is evolving but still has shortcomings in terms of integrating all aspects of interplay between the physical and cognitive components of human response. In light of this, research supporting the sustained development and use of refined cognitive-physical models is gaining momentum and sensible efforts to use task analysis tools that provide integration of both the cognitive and physical components of human response are underway.
Conclusions: This article identifies that although considerable advancements have been made in understanding the temporal variability of human performance, substantial research regarding the factors affecting it, their impacts, and the practical implications are still required.
Originality/value: This study is unique in both the breadth and range of literature considered regarding the factors affecting temporal variability in human performance as well as their implications. Successful consideration of these elements in human-centered complex adaptive systems establishes mechanisms for efficient and effective manpower and risk mitigation planning.

Contents

* Corresponding author. Department of Industrial Engineering and Management Systems, 4000 Central Florida Blvd., P.O. BOX 162993, Orlando, FL 32816-2993, USA.
E-mail addresses: muhsks@knights.ucf.edu (K.S. Muhs), wkar@ucf.edu (W. Karwowski), dkern@ktg-llc.com (D. Kern).

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1. Introduction

In human performance, temporal variability is ubiquitous. Temporal variability, in the context of this literature review, refers to measurable inter- and intra-individual time variations that occur in the human performance of identical tasks. The effects of this variability are seen in the perceptual, cognitive, and physical dimensions of human performance when interacting with complex technologies. Understanding the factors, both internal and external, that affect human performance variability as well as their temporal impacts is an essential element to integrate the human system into complex technological environments. As a result, accurate prediction of the factors affecting temporal variability within the context of individual task performance, as well as the development, refinement, and use of reliable tools in assessing this variability has been a major focus in research for well over 50 years. In fact, as early as 1931, Raymond Dodge (1931) cited relevant perspectives on human performance variability in a seminal text on the topic:

> "The more accurately observations are made the more conspicuous human variability becomes …. The scientific question is not the existence of variability, but how much, under what conditions, and with what consequences." (p.10)

Since that time, significant understanding of the individual elements and organizational factors that impact human temporal variability have been gained through discerning research and broad coverage in literature. Components of the research (Maynard et al., 1948; Hick, 1952; Hyman, 1953; Fitts, 1954) have been generalized and extremely far reaching in the field of Human Factors and Ergonomic (HF/E) Sciences, whereas others (Chan et al., 2003; Chen and Joyner, 2006; Stanton and Baber, 2008) have been exceedingly limited in their scope and application. This variance is not unexpected given the broad desire to create both generalized and adaptive rules to human response variability as well as a recognition that context specificity of the task plays a significant role. The variance, as seen in the literature, is also indicative of the shift in human sciences from prescriptive to descriptive models in terms of a rational performance standard in modeling the "actual behavior" as described by Rasmussen (1997). Over time and based on the diverse uses of human response data, an ambiguous and myopic divide has appeared in the literature between cognitive and physical human models. However, in order to fully appreciate the aggregate temporal variability in human task performance, full and integrated consideration must be given to both the cognitive and physical components of human performance as well as to any interplay that exists between them. Fortunately, recognition and advocacy for the need of combined cognitive-physical models is seen to be gaining momentum within the HF/E sciences community literature (Zhang, 2003; Badler et al., 2005; Fuller et al., 2010; Marras and Hancock, 2014). In addition, task analysis tools have begun limited integration of both the cognitive and physical response aspects of human performance (Allender, 2000; Gore et al., 2008; Wong et al., 2010). This integration synthesizes the nature and implications of biological factors, learning ability, and organizational task design as well as the respective impacts on human temporal variability from either an inter- or intra-individual basis. As a consequence, meaningful consideration must be given to the mechanisms, taxonomy, and time responses of human task performance as well as to the factors that influence the response itself, if one is to fully understand and contribute to the growing body of knowledge on this topic. Thus, we systematically reviewed the literature to provide a critical assessment of the human response temporal variability in performance of tasks, its cumulative impact, and the factors that affect it.

2. Methods

This systematic literature review was carried out according to the guidelines of Preferred Reporting Items for Systematic Reviews and Meta-Analyses (PRISMA) (Moher et al., 2009). No pre-established or registered protocol existed for this review. The review protocol developed for this systematic review was designed to reduce the possibility that the review would be influenced by research expectations. Protocol development specified the research questions and the search strategy.

2.1. Research questions

Based on the objective of this systematic review described in the abstract, the following research questions were derived and form the basis for this literature review:

- RQ1. How has the current research of human temporal response evolved?
- RQ2. How can current research of human temporal response be classified?
- RQ3. What is the current state of human temporal response research with respect to the identified classification architecture?
- RQ4. What can be learned from current human temporal response research that will lead to topics for further investigation?