

# Viewing the Workload of Vigilance Through the Lenses of the NASA-TLX and the MRQ

**Victor S. Finomore Jr.**, Air Force Research Laboratory, Wright-Patterson Air Force Base, Ohio, **Tyler H. Shaw**, George Mason University, Fairfax, Virginia, **Joel S. Warm**, Air Force Research Laboratory, Wright-Patterson Air Force Base, Ohio, **Gerald Matthews**, University of Cincinnati, Cincinnati, Ohio, and **David B. Boles**, University of Alabama, Tuscaloosa

**Objective:** The aim of this study was to compare the effectiveness of a new index of perceived mental workload, the Multiple Resource Questionnaire (MRQ), with the standard measure of workload used in the study of vigilance, the NASA Task Load Index (NASA-TLX).

**Background:** The NASA-TLX has been used extensively to demonstrate that vigilance tasks impose a high level of workload on observers. However, this instrument does not specify the information-processing resources needed for task performance. The MRQ offers a tool to measure the workload associated with vigilance assignments in which such resources can be identified.

**Method:** Two experiments were performed in which factors known to influence task demand were varied. Included were the detection of stimulus presence or absence, detecting critical signals by means of successive-type (absolute judgment) and simultaneous-type (comparative judgment) discriminations, and operating under multitask vs. single-task conditions.

**Results:** The MRQ paralleled the NASA-TLX in showing that vigilance tasks generally induce high levels of workload and that workload scores are greater in detecting stimulus absence than presence and in making successive as compared to simultaneous-type discriminations. Additionally, the MRQ was more effective than the NASA-TLX in reflecting higher workload in the context of multitask than in single-task conditions. The resource profiles obtained with MRQ fit well with the nature of the vigilance tasks employed, testifying to the scale's content validity.

**Conclusion:** The MRQ may be a meaningful addition to the NASA-TLX for measuring the workload of vigilance assignments.

**Application:** By uncovering knowledge representation associated with different tasks, the MRQ may aid in designing operational vigilance displays.

**Keywords:** vigilance, mental workload, NASA Task Load Index, Multiple Resource Questionnaire, multiple resources, stimulus presence/absence, simultaneous/successive discriminations, multitasking

## INTRODUCTION

The study of vigilance or sustained attention focuses upon the ability of observers to detect and respond to unpredictable and infrequent signals over extended periods of time (Ballard, 1996; Davies & Parasuraman, 1982; Hancock, 2013; Warm, 1984, 1993; Warm, Parasuraman, & Matthews, 2008). This aspect of human performance is an important concern for human factors and ergonomic specialists due to the critical role that vigilance plays in a wide array of automated human-machine systems in aviation, industrial process and quality control, medical monitoring and screening, and airport and border security (Warm, Parasuraman, et al., 2008). Several studies have shown that accidents ranging in scale from minor to major are often the result of poor vigilance on the part of human operators (Hawley, 2006; Molloy & Parasuraman, 1996; Warm, Parasuraman, et al., 2008). Consequently, an understanding of the factors that influence vigilance performance and their underlying mechanisms is crucial for system integrity and public safety (Nickerson, 1992).

Due to their monotonous and repetitive character, there has been a long-standing belief that vigilance tasks are understimulating work assignments that impose little information-processing demand upon observers (Nachreiner & Hanecke, 1992; Robertson, Manly, Andrade, Baddeley, & Yiend, 1997). However, studies using the NASA Task Load Index (NASA-TLX; Hart & Staveland, 1988) as a measure of the mental demands imposed on observers by vigilance tasks have challenged those views and indicated that information processing in vigilance is highly demanding (Johnson & Proctor, 2004; Warm, Matthews, & Finomore, 2008; Warm, Parasuraman, et al., 2008).

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Address correspondence to Victor S. Finomore, Air Force Research Laboratory, 2610 Seventh St., Wright-Patterson, OH 45433, USA; e-mail: victor.finomore@wpafb.af.mil.

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