Evaluating Human Performance and Advanced Technology
Design in Extreme Environments

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Evaluating Human Performance and Advanced Technology Design in Extreme Environments


Evaluating human performance in extreme environments offers unique challenges to human factors practitioners, researchers, and designers. Existing methodologies do not facilitate making cross-modal comparisons of cognitive-attentional demand levels. The present paper describes a multi-sensory protocol device for the evaluation of workload when assessing human performance and the differential demands placed upon sensory modalities.

Operating in extreme environments offers unique challenges to designers, many of which seek to mitigate environmental performance handicaps through advanced technology use. However, designers must not only take into consideration physical performance limitations imposed by extreme environment (e.g., making psychomotor responses while wearing gloves or while under g-stress), they must also consider any potential cognitive-perceptual impairments arising from operating in extreme environments and while under stress (e.g., Baddeley, 1972; Graybiel & Knepton, 1976; Hancock & Warm, 1989; Manzey, Lorenz, & Poljakov, 1998). However, operators who are cognitively impaired due to extreme environment exposure are, by definition, largely incapable of making accurate subjective reports regarding their state. Therefore, performance-based methodologies of workload evaluation are likely of greatest utility. Additionally, existing methodologies are incapable of differentiating between the demands placed upon sensory information channels across tasks (Meshkati, Hancock, Rahimi, & Dawes, 1995), thereby limiting their utility.

The Multi-Sensory Workload Assessment Protocol (M-SWAP) was developed to meet these needs. It is comprised of a multi-sensory complex counting task administered via a secondary task paradigm and is based upon previous work by Jerison (1955) and Kennedy (1971). The visual component of M-SWAP is administered via a 3.5 in LCD that accepts a video signal from a laptop computer. The auditory component is presented by way of headphones. The tactile component is presented by means of a custom-built wearable vibrotactile display consisting of three vibrotactile actuators attached to an elastic Velcro belt.

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across administrations ($p = .961 - 1.0; p < .03$), and current research efforts seek to further establish the reliability and validity of the protocol.

The versatility of M-SWAP makes it an appropriate tool for performance evaluation in extreme environments and a system design aid for extreme environment technologies with implications for both theoretical and applied research.

References


