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Efficacy of personalized models in discriminating high cognitive demand conditions using text-based interactions

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Abstract

Although high cognitive demand conditions can impair psychological, physical, and behavioral processes without appropriate management, current measurement methods are too cumbersome for continuous monitoring of cognitive demand, and do not account for individual differences. This research uses keystroke and linguistic markers of typed text to construct individualized models of cognitive demand response to discriminate high and low cognitive demand conditions, the results of which can have implications for design of cognitive demand monitoring systems for personalized health management. We constructed within-subject models of cognitive demand response for nine participants and one between-subjects model based on 20 participants. The AUCs for personalized models ranged from 0.679 to 0.953 (Mean=0.826, SD=0.085), significantly higher than chance (p<0.0001) and the 0.714 AUC for the generic model (p=0.002). Although the features in each model were different, the most common features across models are rate of negative emotion, lexical diversity, rate of words over six letters, and word count. These results confirm significant individual differences in cognitive demand response and suggest that measurement methods used in a monitoring system must adapt to individual characteristics. Our research operationalizes the effects of cognitive demand on HCI and contributes a unique combination of text and keystroke features used to detect high cognitive demand situations.

Key Words: Cognitive load, Cognitive stress, Cognitive demand, Consumer health informatics, Health monitoring, Human-centered computing

1. INTRODUCTION

High cognitive demand is a part of everyday life for individuals working in stressful and challenging roles, ranging from high-pressure office work to critical air-traffic control. Consequences for people can include impaired judgment and memory, sleep and motor disturbances, and difficulty performing self-care tasks (Lupien et al. 2007; Semmer et al. 2005). Furthermore, stress produces a high public health burden (American Psychological Association 2015), accounting for up to $190 billion in health care expenditures alone (Goh et al. 2015). This figure does not capture the additional burdens of absenteeism, lowered productivity, and unemployment that add to the public health burden. However, people can mitigate the harmful psychological, physical, behavioral, and performance consequences of high cognitive demand if they engage in healthy stress management behaviors such as relaxation exercises (Varvogli and Darviri 2011).

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