Do cognitive assistance systems reduce operator workload?

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Abstract

As the operators' tasks in complex human-machine systems are often difficult and cognitively demanding, today more and more cognitive functions are aided or completely carried out by automated assistance systems (e.g. decision or diagnostic support systems in process control). One major purpose of providing such automated assistance is to reduce operator workload. Adding a system, however, also means adding tasks and complexity to a work environment. Thus, workload reduction is not granted when cognitive tasks are automated.

The present study addresses the impact of the introduction of automated assistance systems on operator workload in process control. Twelve participants were asked to detect, diagnose and repair any malfunctions occurring in a process control simulation (AutoCAMS). This had to be performed manually or was supported by automated assistance systems differing in their degree of automation. Workload effects were assessed with subjective (NASA-TLX), physiological (heart rate variability, HRV), and performance indicators (secondary task reaction time, RT).

Automation support significantly increased overall performance. Furthermore, subjective workload ratings were significantly lower in the assisted conditions as compared to the manual condition. This latter effect was not reflected in the HRV and RT measures, although these measures were sensitive to workload changes due to the presence or absence of faults. Possible explanations for the observed dissociation of workload measures are discussed.

Introduction

Many areas of human work are characterized by an increasing degree of automation, e.g. ground-, sea- and air transportation, chemical and power plants, and even health care (Sheridan, 2002). As the operators' tasks in such systems are often difficult and cognitively demanding, today more and more cognitive functions are automated, i.e. aided or completely carried out by assistance systems. Besides increasing performance, safety, and reliability of the overall system, one purpose of introducing