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EDITORIAL SPECIAL ISSUE

Cognitive Ergonomics for Situated Human-Automation Collaboration

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The ever-increasing involvement of computer technology in work and living environments—for training and actual task performances—sets continuously new challenges for cognitive ergonomics in diverse domains like transport, crisis management and healthcare [1]. A major challenge is to harmonize the technology development to the dynamics and complexity of the social, cognitive and affective processes in these environments, taking into account of the diversity and multiplicity of human needs, cf. [2]. Such a harmonization comprises effective and efficient human-automation collaboration that proves (1) to be resilient for critical situations and (2) to facilitate creative problem solving in such situations. Current research focuses on collaborative artefacts that help to establish these two effects by enhancing work team's conditions, knowledge and capabilities for acting in a safe and healthy way. For example, studies on flying, driving, and sailing provide requirements for pilot-automation collaboration that brings about adequate recover piloting behaviour after a “failure”, cf. [3, 4]. As a second example, recent research on shared situation awareness of distributed teams in crisis management provide support that may improve team coordination and corresponding performance [5]. For the development of such human-automation collaboration, cognitive ergonomics methods are needed for deriving and testing of the “situational” requirements systematically, cf. [6]. For example, game-based evaluations with Virtual-Reality tools can help to train for new situations or to test specific artefacts [7]. Furthermore, a combination of scenario-based investigation and controlled lab experiments can, for example, help to study automated assistant functions to support therapists in high demand situations when treating multiple patients simultaneously over the internet [8]. As a final example, user experience sampling methods that apply advanced interaction events analysis [9, 10] or sensor technology can improve the insight into situated activities over time (such as heart-rate, eye tracking), but it might prove to be difficult to apply in high-demand environments, e.g. [11].

This special issue provides studies on new artefacts and analysis methods that contribute to the development of the envisioned collaboration as described above. It is a selection of the 25 papers presented at the European Conference on Cognitive Ergonomics 2010 that was held in Delft, the Netherlands. Thirteen extended versions of these papers were submitted to the special issue, of which seven were selected to be included in the special issue after an additional review round. Three papers in the special issue address collaboration and complexity in the safety, and emergency response domain. As plans are to fully automate the Helsinki Metro, Karvonen, Aaltonen, Wahlström, Salo, Savioja and Norros [12] studied the current task of the train drivers. They conclude that if the identified critical roles of the drivers are not accounted for in a future fully automated system, the quality of the service, but also safety could be affected. Norros, Liinasuo and Hutton's [13] contribution to this special issue is a method for evaluating new technology and to anticipate future activity and changes in work demands. They examine the proposed method in a case study on emergency response activity. The method includes a realistic test situation in which two, the current and the new emergency response activities, run in parallel. The third paper focuses on the creation of a situation map for a disaster response. Gunawan, Alers, Brinkman and Neerincx [14] report on a study in which participants on different locations collaborate in creating a situation map of an incident. The study shows that an additional stage with increased collaboration channels could improve the quality of the map, and that the map making process could be positively supported by allowing partners to explicitly state their confidence in the observed objects and events.

Collaboration in a shared task was also a key element of the work reported by Chellali, Dumas and Milleville-Pennel [15]. They created a collaborative virtual environment in which pairs could train a medical needle insertion task. Based on their experiment, they conclude that compared to conventional training methods, their training environment improve the individuals' collaborative performance. Here training is a strategy to prepare individuals to cope with complexity. Likewise serious gaming is therefore also receiving more research attention. Its challenge is to combine learning with entertainment. To do this Wouters, Van Oostendorp, Van der Spek and Boonekamp [16] suggest using foreshadowing and back story technique. To support designers with this, they put forward game discourse analysis. Although they did not find a direct effect on learning, the authors found in their study that this technique resulted in more curiosity among players.

Information technology can also change the nature of the complexity, the work activities, and the resulting outcome. This was the focus of Wojtczuk and Bonnardel's contribution [17]. They studied the activities of professional designers and their design when using manual design methods or computer-aided design (CAD) systems. They also asked judges from different backgrounds (designers, teachers, retailers, and users) to assess the designs. They found that the judges had a preference for design created with CAD systems.

Complex tasks are often also studied by using computational models. For example Cole, Gwizdka, Liu, Bierig, Belkin and Zhang [18] made a contribution towards modelling information search behaviour. They study eye movement patterns of journalists and genomics when they performed an information search task. The authors conclude that task features can be inferred from transitions between scanning and reading behaviour, and the amount of text processed.

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