

Human-Technology Interaction in a Digital World - Challenges of Human-System Integration

We are living in a world that is increasingly pervaded with digital technology. As human-technology interaction becomes an essential part of more and more contexts in our everyday lives, the breadth of topics covered by researchers from the field of engineering psychology is growing. The present symposium demonstrates the wide spectrum of engineering psychology research with examples from the fields of workplace technology, health technology, robotic applications, and aviation. The symposium also explicitly addresses the fact that examining and designing technology interaction is not only an issue of cognitive information processing, but also depends on motivational, emotional and social processes. Also the issues around user diversity are taken into account with contributions that present methods to assess user diversity in technology interaction and examine the role of personality and other individual-difference variables to better understand the dynamics in user-technology interaction. The contributions to the symposium also show the wide variety of methodological approaches used in current engineering psychology research, from laboratory experiments with quantitative data to studies in field settings with qualitative interviews. With this approach of bringing together diverse research works that address the common theme of human-technology interaction in a digital world, the symposium provides a broad picture on current findings regarding challenges of human-system integration and how these are addressed by different research groups from the field of engineering psychology.

[1]

Differing Affinity for Technology Interaction in the Workplace and Consequences for eGovernment Applications

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Research Question:

Even though workplaces have become increasingly digital, people differ how well they like to interact with technology. This affinity for technology interaction (ATI) seems to be stable over time. ATI becomes increasingly relevant with recent eGovernment initiatives, both for civil servants and the public at large, as successful digital interaction within and with government agencies becomes crucial for all members of society.

But what are the consequences of differing affinity for technology interaction (ATI) in the workplace and especially for eGovernment?

Research Design:

We examine the role of ATI in the workplace, esp. in the context of eGovernment, with surveys and in usability tests.

Results:

Results will shed light on the relationship between ATI and usability of work-related applications (e.g., effectiveness, efficiency, learnability satisfaction), esp. in the area of eGovernment.

Limitations / Theoretical / Practical Implications:

The current research focuses on selected applications in the field of eGovernment and studies German citizens and public servants. Results will have implications regarding the role of ATI for the success of workplace applications and work-related trainings, esp. for the development of eGovernment applications and digital citizen participation/communication.

Relevance / Contribution:

This work will shed light on an important personality variable in these work-related contexts, which, if neglected, could negatively influence civil servants' performance and acceptance, and exclude citizens from participation.

[2]

Activity tracking gone wrong - Motivational costs and abandonment of wearable activity tracker usage

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Research Question:

Wearable activity trackers are a promising solution for motivating users to increase physical activity. Unfortunately, many users discontinue activity tracking after a few months, probably impeding large-scale health effects. For identifying long-term adoption barriers, it is crucial to understand the reasons of former users for abandoning wearable activity tracking.

Research Design:

With two online surveys, we investigated (S1) negative consequences of activity tracking on motivation for physical activity (N = 210 current users) and (S2) reasons for tracker abandonment (N = 159 ex-users). In both studies, selected aspects of user diversity (i.e., personality, tracking motivations, usage patterns) were taken into account to shed light on psychological processes underlying motivational impairments and abandonment decisions.

Results:

S1 showed that motivational losses that become apparent in situations when the tracker is not available play a role in everyday usage, especially when users stated to be extrinsically motivated to track. S2 revealed that a decreasing tracking motivation was the most prevalent reason contributing to abandonment decisions, followed by a disruption of the tracking routine and changes in priorities or life circumstances. Moreover, user diversity variables were linked to abandonment reasons.

Limitations:

Based on our study design, causal inferences cannot be drawn. Further, the gender distribution in both samples has not been even.

Theoretical / Practical Implications:

Our findings underline the crucial role of user diversity variables regarding negative motivational effects of activity tracker feedback and concerning tracking discontinuance. Further, the findings indicate the significance of tracking demotivation for tracker abandonment. Hence, tracker feedback should strengthen autonomous tracking motivation (i.e., emphasize users' self-determination).

Relevance / Contribution:

Our studies conduce to a deeper understanding of user-tracker interaction, especially regarding usage motivations and usage barriers.

[3]

Evaluating the design parameters of RSVP displays

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Research Question:

The rapid serial visual presentation (RSVP) of single words or phrases, one after the other, has been proposed as a way to overcome this challenge of presenting text on small displays, e.g., smartwatches. We investigated how the alignment and presentation speed could influence reading comprehension, subjective workload, and the neural EEG correlates for cognitive load (ie, alpha power) and task engagement (ie, theta power).

Research Design:

Eighteen participants read a one-page text excerpt as a pdf document, answered 10 comprehension questions and respond to a NASA-TLX questionnaire. Subsequently, they performed the same task with different text, nine times, with an RSVP viewer that varied for text alignment and presentation rate.

Results:

We found that using RSVP of 350 and 500 words per minute (wpm) significantly reduced reading completion times, relative to the mean speed of approximately 293.4 wpm. However, this came at a cost to reading comprehension and subjective workload. More interestingly, higher presentation speeds resulted in less cognitive load (ie, higher alpha power) and less engagement (ie, lower theta power). Manipulations of text alignment did not have a significant influence on any of our measures.

Limitations:

The trend of alpha power for cognitive load contradicted our predictions and was interpreted post-hoc. This interpretation should be verified with a follow-up study.

Theoretical / Practical Implications:

This study shows that presentation rates is the limiting factor of RSVP displays. Improvement in reading speeds can be achieved but this comes at a cost of reading comprehension that is likely to be due to an inability to process and engage with the displayed information.

Relevance / Contribution:

This work combines EEG measurements with conventional metrics of evaluating novel displays for text presentation to understand why basic design parameters can limit usability.

[4]

Initial reactions to an autonomous service robot in public space: an interview study

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Research Question:

Robots are capable of performing more and more complex tasks – also in public areas. Up to now it is an open question how people's spontaneous reactions are characterized. In an interview study passers-by were interrogated on their first impressions and reactions.

Research Design:

Within one week in a semi-structured interview N = 54 persons were asked about their initial impression of an autonomous cleaning robot (ADLATUS CR 700, 300kg) they were passing by while it cleaned the floor at the train station of Ulm. In the interview questions to spontaneous thoughts, reactions, fears, hopes, critical events and design wishes were asked. The interview took ten minutes on average.

Results:

Findings underline that robots in public spaces are in general acceptable nowadays and that they lead to a great deal of interest. Furthermore, some specific fears in regard to predictability and

controllability became clear. These fears are discussed in relation to critical events and associated design wishes. Especially concerns in relation to potential job losses were mentioned.

Limitations:

Further studies are indicated investigating initial reactions to robots with additional characteristics (e.g. higher degree of anthropomorphism) in further situations (longer interactions, other task contexts).

Theoretical / Practical Implications:

Study findings indicate that robots in public spaces are basically acceptable. Respecting fundamental fears in the design of the appearance and the interaction concept of robots might increase robot acceptance.

Relevance / Contribution:

The introduced study provides first basic answers in regard to spontaneous expectations, fears and design wishes in regard to service robots in public spaces.

[5]

Enhancing Transactive Memory Systems of Multiteam Systems in Aviation

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Research Question:

The highly effective air traffic depends and will also depend in the future on the collaboration of human protagonists from different organizations. The project “Inter-Team Collaboration” (ITC) aims to provide system engineers with tools and concepts for human factors that allow systemic access to the social side of socio-technical systems. A main question is how to induce collaborative decision-making within the dynamic environment of air traffic management (ATM) in order to make it more adaptive and resilient.

Research design:

A crucial factor for collaboration in multi-team systems is the transactive memory system (TMS), built up and maintained by the interactions between team members as well as multi-team members. There are currently plans to develop an intervention which would facilitate the formation of TMS structures within the multi-team. Furthermore, a set of methods will be used to assess the TMS structures and communication processes in the laboratory studies and field cases.

A laboratory study is planned to examine the initial TMS intervention under controlled conditions with non-expert participants. In addition to the laboratory study, we will use large-scale simulations in the context of three use-cases with experienced operators in order to investigate these methods. The three cases are, first, the Airport Control Center for Airport Management, second, the sector-less, time-based control of aircraft, and third, the Multiple-Remote-Tower Center.

Results / Practical Implications / Relevance / Contribution

By using real-time simulations with operational experts, the results will have implication what kind of intervention is appropriate for enhancing TMS structures of MTS in aviation and how can TMS structures be measured? In conclusion, the ITC project presents the opportunity to investigate these topics in an interdisciplinary team as well as to bring together different capabilities and competencies for the purpose of investigating transactive memory systems of MTS in aviation on different levels and in an iterative process.

