

Introduction to the Special Issue on Affect Awareness in Software Engineering

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1. Introduction

Affective computing has emerged in the past decade as a multidisciplinary research field concerning the detection, use, understanding, and modeling of emotions and affect in computing systems. Nowadays, affective computing is an established discipline whose methods and techniques are being applied to many application domains. This special issue reflects an emerging trend to study the role of affect in software engineering. Researchers have even created focused venues such as the International Workshop on Emotion Awareness in Software Engineering (SEmotion), at the International Conference on Software Engineering (ICSE),¹ now in its third edition, and the International Workshop on Affective Computing for Requirements Engineering (AffectRE), co-located with the Requirements Engineering conference (RE).²

Affective states such as personality traits, attitudes, moods, and emotions are a crucial part of people's everyday performance at work [1]. This applies also to software development [2, 3, 4] which is also well-known as intellectual, creative problem-solving activity. To achieve the best chance of successfully executing software engineering projects, stakeholders must demonstrate positive affect (such as trust or appreciation), agree on display rules for emotions and moods, and hold mutual commitment to the project goals. Leveraging emotion awareness in software engineering could enhance development performance, software quality, mood regulation within a project team, and lead to fruitful interactions with all stakeholders.

Software developers experience a wide range of emotions in their work [5, 6, 7]. As new technologies and requirements constantly arise, developers also should be able to adapt to flexible work conditions. Negative affective states (e.g. resentment or frustration) might become an obstacle when reacting to undesirable facts, such as negative customer feedback [8]. Similarly, moods can impact the cognitive processes involved in learning new programming languages and APIs, solving tasks with high reasoning complexity, and performing typical programming tasks [5, 4]. Finally, software engineering requires a great deal of social interaction, which leads to the widespread sharing of affective states. Awareness of the project mood [9, 10, 11],

¹<http://collab.di.uniba.it/semotion/>

²<https://mast.informatik.uni-hamburg.de/affectre/>

communication style [12, 13], and teammates' responses might help developers wisely lead, manage, work together, and improve the outcomes of social activities [8].

The goal of this Special Issue is to present the opportunities and challenges of combining affective computing studies with research on human aspects in software engineering. On one hand, we aim to investigate the impact of affective states (emotions, moods, attitudes, personality traits, etc.) on individual and group performance, commitment, and collaboration in software development. On the other, we aim to foster the consideration of issues posed by exploiting affective computing as a new method for empirical software engineering. The call for papers invited high-quality research articles addressing challenges posed by affect awareness in software engineering. In this call, extended papers from SEMotion '17, the Second International Workshop on Emotion Awareness in Software Engineering, (co-located with ICSE³) were also eligible for submission.

After a careful review process in which each submission received at least three reviews, five high quality papers were accepted for publication. We congratulate the authors of the accepted papers and thank everyone who submitted a contribution to this Special Issue. We also thank the reviewers for their hard work, and the editors of the Journal of Systems and Software for accepting our Special Issue proposal and assisting us during the entire process.

2. An Overview on Affect Awareness in Software Engineering

Of the five papers in this issue, two are related to the antecedents and consequences of affect in software development. The third paper investigates the role of trust in distributed development teams. The fourth and the fifth papers address the role of affect in requirements engineering and the topic of sentiment and emotion mining from developer communication channels. In this section, we summarize the main contribution of each paper and frame them in the context of recent advances in research on affect awareness in software engineering.

2.1. *The Impact and the Antecedents of Affect in Software Development*

The first paper, 'What happens when software developers are (un)happy,' by Graziotin *et al.*, reports on a survey-based study aimed at investigating the consequences of positive and negative emotions experienced by software developers. The authors analyzed over 300 questionnaire responses to identify 42 consequences of unhappiness, 32 consequences of happiness, and their correlation with developer mental well-being, the software development process, and generated artifacts. Among the consequences the authors highlight are the impacts of emotions on cognitive performance, creativity, and productivity, and the emotional impact of stress, anxiety, burnout, and depression. Prior research recently stressed the importance of early detection of negative emotions like frustration to support developers experiencing difficulty, thus preventing burnout and loss of productivity [14].

The resulting classification scheme can be used as a guideline for researchers interested in investigating the impact of emotions in software development. Furthermore, it can be used to support practitioners in identifying the detrimental effects of negative affect on their own well-being and job performance. The study fits in the scope of a study series that the authors are conducting to assess the distribution and impact of positive and negative affect among developers.

³<http://collab.di.uniba.it/semotion17/>

In particular, this paper is an extension of the authors' previous contribution, published at the SEmotion '17 workshop [2].

The second paper, 'Positive Affect through Interactions in Meetings: The Role of Proactive and Supportive Statements,' by Schneider *et al.*, describes an empirical study involving 155 student developers in 32 software projects. The authors found that group emotions experienced during the first plenary meeting of each team are positively influenced by proactive statements when they are immediately followed by supportive ones, that is by manifestation of intention to support the achievement of the proposed action. Their empirical evidence suggests that such meetings should no longer be perceived as annoying black boxes, but as an engaging step of the software development process that can be leveraged to foster the project success.

2.2. *Affect in Globally Distributed Teams*

The third paper, 'Bridging the Gap Between Awareness and Trust in Globally Distributed Software Teams,' by Trainer and Redmiles, also addresses the study of affective dynamics in teams. In particular, the paper investigates the interrelationship of awareness and trust in global software development. The authors report qualitative results from extensive field study showing that trust still represents a key challenge for distributed teams. Based on this evidence, they investigate how developers form attributions of one another. Furthermore, they design a collection of visualization widgets for addressing specific issues found in the field and evaluate their effectiveness in a controlled study involving both students and professional developers. The results illustrate that participants who use visualizations of work-related information make more accurate attributions and more accurately perceive the trustworthiness of remote collaborators in relation to actual circumstances. Based on their findings, the authors advocate for awareness as a means to yield more appropriate emotional responses, and thereby more awareness of one's emotional state in team work. The beneficial impact of such forms of awareness could be useful, especially in the early stages of collaboration. This paper fits in the scope of current research exploring the role of awareness in distributed teams [15, 16], the impact of personality traits such as the propensity to trust in successful pull requests [17, 18], and the role of affective trust in agile practices for requirements engineering [19].

2.3. *Affect Awareness in Requirements Engineering*

The fourth paper, 'Emotion-oriented Requirements Engineering: A Case Study in Developing A Smart Home System for the Elderly,' by Curumsing *et al.*, proposes an emotion-oriented requirements engineering approach to help identifying, modeling, and evaluating emotional goals. The authors also explain how the proposed approach is used in developing smart home platform for elderly people, in which emotion-driven requirements were introduced to fulfill the emotional goals of users. This study fits in the scope of recent research on leveraging users' emotions and opinions as mined from app stores [20] or user-generated content on microblogs [21] for software maintenance and evolution tasks. Guzman and Maalej proposed an approach based on fine-grained sentiment analysis of users' reviews to support app developers in systematically analyzing user opinions about single features to e.g. support work prioritization [22]. Understanding negative emotions towards specific objects (e.g., APIs, app features, etc.) [23] could be leveraged in customer-support analyst conversations to find indicators of when a particular support ticket may be escalated [24].

2.4. Emotion Mining from Developers' Communication Traces

Recent research has provided evidence that software developers experience and express a wide range of emotions throughout the rich ecosystem of their communication channels, including issue-tracking systems [7, 23], technical Q&A sites [13], and social coding sites [25, 26, 27]. The fifth paper, 'SentiStrength-SE: Exploiting Domain Specificity for Improved Sentiment Analysis in Software Engineering Text,' by Islam and Zibran, describes a sentiment analysis tool specifically developed for the software engineering domain. SentiStrength-SE implements an unsupervised approach to classification of texts based on their positive, negative, or neutral polarity. A recent benchmark study [28] demonstrates how SentiStrength-SE, together with other SE-specific tools such as SentiCR [29] and Senti4SD [30] overcomes the limitations posed by the off-the-shelf sentiment analysis tools [31].

3. Conclusion

The papers in this Special Issue represent an overview of the most recent research advancements in many facets of affect awareness and software engineering, from requirements engineering to collaborative software development, to mining software repositories. They cover only part of the field, highlighting the first set of stable, reliable results. We expect further advancement in the near future, e.g. perhaps towards the development of real-time, sensor-based recognition of emotions of software developers [32, 6]. We hope readers find that the content of this Special Issue inspires their future research.

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