Biosignal-Informed Support for Program Comprehension: Developer Acceptance and Predictive Validity

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Abstract (should be within 1st page)

This thesis shows that program comprehension accuracy can be predicted from heart-rate metrics in support methods acceptable to software developers. Developers sometimes fail to notice their misunderstandings of code, causing to defects. Prior studies have shown that comprehension-error risk can be predicted from heart rate and other biosignals. However, such prediction is not yet practical because they have focused only on its feasibility, without examining whether the resulting support methods would be acceptable to developers. To address this issue, we adopted an acceptance-first design with an acceptance survey and a predictive validity test. In the survey, developers rated support methods derived from earlier software engineering studies using biosignals. The survey identified two acceptable methods: Break Reminder and Code Check Reminder. To test predictive validity, we collected comprehension scores and heart-rate data in a program-comprehension experiment. The analysis yielded two findings. For Break Reminder, task-level comprehension accuracy can be predicted from pre-task heart-rate variability. Thus, this method can prompt breaks before high-risk tasks without intrusive notifications during the task. For Code Check Reminder, line-level comprehension accuracy can be estimated from heart-rate metrics weighted by line-viewing time. Thus, this method can prompt developers to double-check code lines that are likely to be misunderstood without repeating the entire task. Collectively, these findings show that Break Reminder and Code Check Reminder are acceptable and that their heart-rate-based prediction schemes have predictive validity for program comprehension accuracy. This indicates a feasible path toward adopting psychophysiological state-aware support for software development.