



**University
of Victoria**

Graduate Studies

Notice of the Final Oral Examination
for the Degree of Doctor of Philosophy

of

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**“Visualizing Personal Data in Context: An On-Calendar Design
Strategy for Behaviour Feedback”**

Department of Computer Science

Monday, August 15, 2016

9:00 A.M.

David Turpin Building

Room A144

Supervisory Committee:

Dr. Melanie Tory, Department of Computer Science, University of Victoria (Co-Supervisor)

Dr. Lyn Bartram, Department of Computer Science, UVic (Co-Supervisor)

Dr. Robert Gifford, Department of Psychology, UVic (Outside Member)

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Dr. Eun Kyoung Choe, Information Science and Technology, Penn State University

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Dr. Fayez Gebali, Department of Electrical and Computer Engineering, UVic

Abstract

Visualization tools are frequently used to help people understand everyday data in their lives. One such example is visualization in behaviour feedback tools. Behaviour feedback tools are used to try to help people improve their health or personal wellbeing or to carry out sound environmental sustainability practices. However, understanding and reasoning about personal data (e.g., pedometer counts, blood pressure readings or home electricity consumption) or gaining a deeper understanding of one's current practices and learning how to make a change can be challenging when using data alone. My literature review of this field showed that two of the main challenges in actual practice are providing a context in which to reason about the data and reducing the cost of maintenance to fit those tools into everyday life routines. Thus, I propose to integrate time-varying feedback data within a personal digital calendar. This combination of calendar and feedback data can provide contextual information to interpret data and make the data accessible in an attentionally ambient way that is suitable for maintaining awareness. I propose that the familiarity and common practice of using digital calendars can minimize the cost of learning and maintenance for people and easily fit into one's daily life routines.

The viability of this approach was confirmed in my quantitative lab experiments. The results showed that visualization of feedback data integrated on a digital calendar is comprehensible, and it does not interfere with regular calendar use with proper visual encodings. After confirming the viability of my proposal, I implemented the on-calendar visualization as a web application that was synchronized with Google Calendar API and a real-time feedback data stream. To further investigate this approach in a real life situation, I deployed the application in the field for longitudinal field studies: two case studies as pilot deployment and an eight-week field study. Results showed that people liked the idea of integrating feedback data into their personal digital calendars. It required a low cost in learning and maintenance. The calendar events provided rich context for people to visualize and reason about their feedback data. The design enabled people to quickly identify and explain repeated patterns and anomalies. Meanwhile, I found that people's existing information use habits (in this case, how they use digital calendars) can highly influence the effectiveness of the feedback design. Moreover, I derived a feedback model that identifies basic components in feedback design and illustrates the role of feedback tools. With that I articulated possible design barriers that could prevent ongoing use of feedback tools. Reflecting on the effects of the on-calendar design approach, I discussed design implications inspired by this work.

This work introduces a reflective approach in feedback design that can easily fit into people's existing information ecosystem (specifically, a personal digital calendar in this work). The main contributions of this thesis are: the first systematic literature review of personal visualization design used in everyday life; the design and implementation of an on-calendar design that integrates feedback data on people's personal digital calendars to provide context for reasoning and support easy access for ongoing use; the extended definition of ambience from spatial location to attentional demand; a viability study to confirm the on-calendar design approach; longitudinal studies to investigate the effects of the on-calendar design approach and the feedback model of design mechanism to inspect ongoing factors in feedback designs.