Moving forward: Supporting physical activity behavior change through intelligent technology

Physical activity is an important prerequisite for global health. Despite the well-known benefits for both physical and mental health, approximately 50% of the adult population in western countries are less physically active than recommended by health authorities. Therefore, effective and engaging interventions are needed to increase and maintain physical activity levels. It is believed that modern (mobile) technology provides an opportunity to support people to become or remain physically active.

The research presented in this thesis investigates several aspects of using technology to stimulate behavior change for physical activity, and it proposes the design of an intelligent physical activity promotion app. In doing so, techniques from (mobile) technology and artificial intelligence are applied, as well as scientific knowledge from human-directed disciplines within psychology and social sciences. The role of social processes in establishing (and maintaining) healthy behavior is considered in particular.

First, the state of the art of mobile behavior change interventions for physical activity and user preferences of the target population are discussed, in order to gain insight into the requirements for such interventions. The results show that it is important to make better use of available knowledge and technology: on the one hand, incorporating more behavior change techniques (that are associated with effectiveness), and on the other hand, implementing more technology (that enables smarter and more tailored support). Research into the user preferences showed that they would like an intervention that has the impression of a virtual personal coach.

Second, the role of computational models in the development of mobile interventions for physical activity is discussed. A computational model for psychosocial influences on physical activity behavior is explored in depth, with a focus on how to apply it in a real-life behavior change system. Initial validation studies of the model show promising results, thereby justifying its incorporation in Active2Gether’s reasoning engine. Also, a parameter tuning algorithm is applied to increase the diversity of the simulation outcomes, which provides further support for applying the model in the reasoning engine.

Next, the role of social processes in establishing behavior change is studied. It is shown that users who choose to join an online community (at some point in time) benefit more from a physical activity promotion program than users who do not participate in the community. Also, the validity of a computational model of social contagion is supported by the results of two different data analysis studies. In addition, this thesis presents an exploration of ways to
exploit such processes in behavior change systems, i.e. by altering connections in a user’s social network to steer social contagion and by selecting other users for social comparison while taking the user’s preference into account. These findings provide important guidelines for developers of behavior change interventions.

Finally, this thesis provides a complete description of the process of developing and evaluating an innovative mobile behavior change intervention for physical activity. Also, several improvements for the development of such systems are suggested.

Overall, the work presented in this thesis contributes to the scientific advancement of the domain of intelligent behavior change interventions for physical activity, by investigating several approaches to incorporate the use of technology in analyzing, understanding and supporting human behavior. In addition, this thesis presents practical steps and insights with respect to the development of such an intelligent physical activity promotion intervention. We hope and expect that this work contributes to the further development of sophisticated physical activity interventions, and thereby to a healthier society.