Chapter 12

Discussion and Conclusion

The first chapter started with a motivation section by reflecting on the context of the work and the question why it is essential to study the mental processes which are required to create and optimize a healthy lifestyle in problem domains where a human plays an important role. The thesis has three main parts (besides the first and last). Part II of the thesis discusses mental processes in the context of emotion regulation. In this part we emphasize the role of emotion regulation in the different contexts with respect to different environments and personalities. Furthermore, the role of decision making in emotion regulation was also studied, as there are often multiple options for the choice of a regulation strategy. In the second part, the overall goal still is to support a healthy lifestyle, but it was studied in the context of social processes. In the third part we presented a study about self-monitoring of travel behavior, and a prototype of a personalized coaching system and its evaluation.

1 Revisiting the Research Questions

The Research Questions were organized according to the scheme presented in the following table. The main research question presents the global challenge and is further broken down into the smaller research questions which are addressed by one or more chapters. The main research question in this thesis was: 

How can knowledge and theories from the fields of cognitive, affective, social (neuro) sciences, and state of the art technology based on smartphones, social media and wearables technology be combined to support a healthy lifestyle?

The sub-questions are discussed in different chapters according to the following table.

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1.1 How the main question was addressed

The main research question is covered by all the chapters. The first part of the main research question about knowledge and theories is addressed in Part II and III. Part II presents an investigation of theories about emotions and emotion regulation, and the social cognitive theory. Further exploration of these phenomena was undertaken by creating computational models in order to understand their role by executing specific scenarios. The answer to the main question is further elaborated in Part III. In this part the focus is on social phenomena, the social aspect is integrated into computational models and the role of social aspects in health promotion programs is considered. The question further unfolds in Part IV, where a prototype of personalized e-coaching is described which was developed by employing modern technology and combining theory and evidence based research. The coaching system consists of various parts; for example one of them is a reasoning engine which is based on the computational model discussed in Part II, Chapter 5. Moreover, another important part of the system is that it employs an online social network, which is based on the research presented in Part III that illustrates that a social network can steer behavior.

1.2 How the sub-questions were addressed

Research Question 1

*What domain knowledge and domain theories describe processes that can contribute to adapting a healthy lifestyle and can be used in a computational context?*

The above question was broken down into three smaller questions which are discussed below.

Research Question 1.1

*How can we computationally model emotion regulation and its interaction with depression? For example, how can emotion regulation help an unstable person to avoid depression and how can it help to postpone it for a very unstable person?*

In the literature mood regulation (coping) and emotion regulation is often distinguished (Larsen, 2000). Mood is characterized as a long term feeling which lasts for a longer period of time (Gross, 2015; Larsen, 2000). In Chapter 2 a computational model was introduced that combines the short-term emotional reaction on stressful events with the long-term dynamics of mood. The model is inspired by Gross’s theories of emotion regulation (Gross, 1998). It has been shown that recurrent episodes of stressful events could lead to a depression. A brief account is provided here on how a computational model can be developed that
models these processes. Emotion regulation is a process based on a set of regulatory strategies used by persons to down-regulate their negative emotions or to up-regulate their positive emotions (Bosse et al., 2011; Treur, 2008). The focus in Chapter 2 is on a cognitive reappraisal (re-interpretation) strategy, that involves changing the way one interprets a stimulus or situation, by altering the semantic representation of an emotional stimulus in order to reduce the influence of such a stimulus. It is further analyzed how a process of emotion regulation can help persons maintain a healthy mood in case of the occurrence of stressful events that recur from time to time or even continuously. The model incorporates an earlier model of mood dynamics and a model for the dynamics of emotion generation and regulation incorporating different regulation strategies. Example model simulations are described that illustrate how adequate emotion regulation skills can avoid or delay development of a depression.

Thus, the presented computational analysis shows how regulation of stressful emotions helps unstable persons to avoid a depression, and to postpone it in very unstable persons.

Research Question 1.2

_How can emotion regulation strategies be combined? And what is the role of decision making in the context of the choice for specific emotion regulation strategies?_

To answer this question the possibilities of choosing and combining a number of emotion regulation strategies have been explored. Chapter 3 and 4 discussed this in detail. In Chapter 3 a computational model was introduced which is based on the idea of combining different emotion regulation strategies. In the chapter, a reappraisal strategy is integrated with other strategies, namely expressive suppression and situation modification. A different approach to such integration of emotion regulation strategies can be found in (Bosse, Pontier, & Treur, 2007, 2010); see also (Bosse, Gratch, Hoorn, Portier, & Siddiqui, 2010) for a comparative perspective. The model described in (Bosse et al., 2007; Bosse, Pontier, et al., 2010) is based on a cybernetical view, taking a notion of homeostasis as a point of departure, where every deviation from an assumed norm value for the emotion level triggers an adjustment, thereby using all strategies. In this sense the latter model is a kind of abstract black box model, as it does not use more specific inspiration from the biological and neurological area. The integrated model proposed in the current chapter focuses on this biological inspiration and uses different and more neurologically plausible mechanisms based on that inspiration. An important but often neglected part of the emotion regulation process is a decision making process determining under which circumstances different strategies are selected (Gross, 2015). Chapter 4 proposed and formalized a model of decision making in the
context of emotion regulation. Which strategy is applied depends on a number of factors, such as a person’s context, an internal self-monitoring and assessment concerning the person’s feeling intensity, and the individual characteristics or preferences. The role of monitoring and assessment, and control mechanisms to recognize a type of negative emotion and to choose for one or more strategies have been explored computationally. Both models provided interesting simulation patterns which illustrates the role of decision making process and combining emotion regulation strategies for different personality characteristics. Furthermore, the models can be tuned to specific personality characteristics and events. Two objectives were achieved with help of simulation experiments, first it was demonstrated that the idea of combining different emotion regulation strategies in the occurrences of a high intensity emotion is useful, and second that a monitoring and assessment mechanism is required to detect and apply an appropriate combination of emotion regulation strategies.

Research Question 1.3

What domain knowledge and domain theories related to behavior change can be used in a computational context?

To answer this question various theories about health behavior change were discussed in Chapter 5. A computational model has been studied that implements social cognitive theory of behavior change in order to predict health behavior. The Chapter further discussed the role of behavior change techniques and also shows how different health determinants based on those theories (of behavior change) can be targeted by those techniques and used in mobile support system, e.g., in the form of tailored messages.

Research Question 2

How to design, develop, and implement a health support system or coaching system that combines strong evidence based on modern technology and theories and findings from cognitive and social (neuro)science? Can social processes help in steering a physical activity program? If so, how can a social network component be part of such a kind of support system?

This research question is addressed in Parts III and IV of thesis. Partially, it is answered in Part III which investigates the role of social phenomena concerning a healthy lifestyle. In this part the role of a social contagion was investigated in the context of one empirical study in the domain of physical activity behavior that could help to steer a health program. In Part IV, a prototype of a personalized mobile coaching system is presented. Besides other components of this system, based on the findings of Part III a social component based on an online social
network was also part of it. The system was implemented and applied in a 12-week study; at the end of the study an evaluation was performed on the extent to which the intervention helped participants to improve their physical activity levels. Furthermore, there was also a study conducted which aim was to detect the physical context (important locations, travelling periods and travelling options) of a person in order to motivate and encourage individuals to indulge more in physical activity behavior.

This prototype thus forms an answer to the question how to design such a system. The more specific questions about the techniques used are discussed below.

Research Question 2.1

What is the role of emotion regulation and contagion in socially affected decision making?

This sub question is addressed in Chapter 6. A social agent model is presented that combines mainly three mental processes: emotion-related valuing of decision options, emotion contagion, and emotion regulation to study how socially affected decision making relates to emotion contagion in interaction with emotion regulation. A computational model was developed which integrates these processes. The chapter addresses how decisions can be affected by regulating the emotions involved, and how these emotions are affected by emotion regulation and contagion. Based on the principle of Hebbian learning (Hebb, 1949) the learning was implemented which makes the model adaptive.

Research Question 2.2

To which extent do different nodes in a network influence an individual in a simulated social network depending on the paths from one node to the other? Is it possible to identify and change specific connections in such a social network in such a manner that it has a positive effect on a targeted individual?

This was addressed in Chapter 7. Often in the literature network interventions are discussed to adapt a healthy and avoid an unhealthy behavior. Such interventions used in the structure of the network around the individual to change the behavior of an individual. These kind of interventions are often discussed and applied in the context of a whole group (Borgatti, 2006; Valente & Fujimoto, 2010). Online social networks allow to monitor a behavior and changes in the structure of the network continuously, and hence they enable us to invent and apply interventions at a more personalized level. In this chapter a number of network interventions have been introduced that focus on achieving an effect on a specific individual in a social network. The suggested interventions are based on the identification of strong transitive connections to people with a negative influence
and weak transitive connections to people with a positive influence. Via simulation experiments, the effect of the changes in the structure of the network on the individual have been studied. The aim of the proposed social network interventions is to investigate whether it is possible to design a support system that can influence a person by affecting the social interaction with and between other persons. The simulation experiments have shown that this is the case: it is possible to identify and change specific connections in a network such that it has a positive effect on the targeted individual. The results indicate that changing the strength of nearby connections seems to have more influence than changing very strong/weak connections further away in a path. Larger changes in the connection strengths have larger effects. With respect to the selection of connections that should be changed, it can be concluded that the proposed heuristics performed very well. For all targets that have been considered, it turned out that the connection that was selected to be changed was among the best possible options. Another finding was that changes in connections to sparsely connected nodes have larger effects than changes in connections to highly connected nodes. The proposed network interventions can be used in the context of a behavior change support system. By emphasizing or filtering the information about behavior, intentions or goals that is shared between people in an online social network, it is possible to alter the social interactions and thus the spread of influences throughout the network. Another application would be to suggest a person to make strong ties with more positive people around him or her or restrain completely or to reduce communication with negative people.

Research Question 2.3

Can a social network help in achieving a positive health behavior, and if so, what kind of social phenomena could contribute to it?

This was addressed in Chapters 8 and 9. Online social networks can be used to develop and maintain a healthy lifestyle (Breda, Treur, & Wissen, 2012). A data set of approximately 50,000 individuals was used to extract data that ensured a fair comparison between participants that are willing to become part of an online community and participants that are not. From the set of approximately 5,000 individuals were selected who at some point opted in for the community (consisting of a collection of several smaller connected components), and a number of components was selected. Based on the characteristics of those sub communities, similar individuals were found from the set of individuals who never became part of an online community. The two data sets were analyzed and compared with each other. We were able to conclude that there is a difference in PAL, as the users in the community are already more active at the start. Also, we were able to conclude that the PAL of people in a community shows an increase that is significantly stronger compared to non-community users. Since we balanced the data sets for possibly
confounding factors like gender, time of the year and corporation, it is very likely that the fact that people are willing to become member of the community is the dominant factor that makes a difference for their increase in physical activity level. Although we are not sure of the direction of the causal relation, our findings are a valuable step towards answering the question “does online sharing of physical activity accelerate the impact of a health promotion program”. We can conclude that willingness to participate in an online social network for sharing activity data is associated with an increase in physical activity. Similarly, not wanting to partake in an online community is correlated with no increase in physical activity. Hypotheses were proposed that could explain this phenomenon. For example, one hypothesis is that it is caused by social contagion, i.e., the process of influencing others (sometimes unconsciously) via a network of social relations (Schoenewolf, 1990). Another possible hypothesis is social support, in the sense that community members help each other in performing physical activities (e.g., doing sports together) (Cohen & Syme, 1985). Yet another hypothesis is that social comparison is the driving factor, i.e., that people that chose to share their physical activity level online are stimulated by the achievements of others (Bosse, Duell, Memon, Treur, & Van Der Wal, 2009). These questions require further investigation and provide directions for further research. Nevertheless, these results further support the hypothesis that enabling participants to share their achievements with peers makes physical activity programs more successful to help people achieve a healthy activity level.

Chapter 8 only discusses the first half of Research question 2.3. The findings do not yet answer the question why this is happening. It is still unclear what kind of social phenomenon causes this effect of the community on the participants’ physical activity levels. In Chapter 9 we analyzed one of the hypotheses, i.e., the higher activity levels of the community users can be partially explained by social contagion and partially by the effect of the health promotion program. In order to validate/test this hypothesis, we compare the activity data of the participants with two types of predictions: (1) based on a simple linear model that captures the effect of participating in the program and the online community, and (2) based on a model of social contagion combined with the linear model. The results show that the enriched social contagion model performs better at describing the pattern in the empirical data than the linear model, indicating that some of the dynamics of the physical activity levels in the network can be explained by social contagion processes. This is vital information for designers of health interventions with a social component, as such models can then be used to maximize the benefits of social influence processes.
Research Question 2.4

How to design, develop, and implement a support system with the aim to encourage young adults to adopt a healthy behavior towards physical activity?

- What kind of functionality is required in such a system?
- What is the role of computational models in such a system?
- How can we monitor travel behavior?

These sub questions were addressed in Part IV, Chapters 10 and 11. An account of Active2Gether system was presented in Chapter 10. Before developing the Active2Gether system, we conducted two studies to assess the participants’ preferences and expectations that we can integrate into the intervention. Among all the listed features, participants most liked features that targeted goal setting on the outcome of behavior, self-monitoring of behavior, and self-monitoring of the outcome of behavior. Participants also liked the idea of a personal (virtual) coach that helps the user set goals, while also supporting and motivating the user to achieve self-determined goals.

Chapter 10 discusses in more detail the design, development and implementation of the system. The goal of the project is to combine domain knowledge from experts in physical activity interventions with modern mobile technology to design an intervention that encourages physical activity among young adults. The architecture of the system comprises different components which were linked to various user preferences and studies conducted during the course of the project. The coaching system aims to encourage physical activity among young adults by combining evidence based behavior change techniques with elements from modern (mobile) technology, such as location monitoring and model based reasoning. Additionally, we have discussed the lessons learnt during the design, implementation and evaluation of the system, as well as recommendations for further development and improvement. We believe that these insights will prove helpful to designers and developers of healthy lifestyle interventions, in order to produce effective and appealing coaching systems.

In Chapter 11, we address the self-monitoring of travelling choices. This is one of the essential parts of a support system that can help to foster a change in behavior that prefers active transport over inactive transport. In order to provide support in behavior change or self-monitoring, automatic measuring of (active/inactive) travel behavior is inevitable. This is achieved by combining several types of information: the speed of changing between different significant locations, the registered activity level in that period, and the transportation option that a user has described in the initial questionnaire. Together, this lets us determine whether a person has taken active transport (bike or walk) or used non-active modes of transportation, such as a car, tram, bus, or metro. We can conclude that it is difficult to find transition
periods based on GPS locations only. Our hypothesis is that this is caused by the fact that there are many gaps in the GPS logs. Several factors may have contributed to this problem, for example the smartphone is not charged, an accurate location cannot be obtained especially when inside a building or a transition is not reported correctly. However, for the transition periods that were correctly identified, we show that travel modes can be very well detected based on GPS speed. Adding accelerometer data to GPS speed only marginally improves detection performance. The results of travel mode detection are comparable to other literature.

2 Contributions to Software Design

Addressing human-centered modelling and computing with a focus mainly on the understanding of the context and influencing people both in an individual and social environment was one important contribution. However, the contributions of the work presented in this thesis also included designing and developing the technical infrastructure for the Active2Gether system. The aim of the Active2Gether project is to develop an intelligent coaching system that supports people to make healthy lifestyle choices, in particular regarding physical activity. The Active2Gether system was designed according to an architecture that comprises five main components,

(1) an app on a mobile phone
(2) a commercial activity tracker
(3) a database with user (activity) data and persuasive messages
(4) a model-based reasoning engine to interpret the data and predict effect of different coaching strategies
(5) a communication engine that selects and sends questions and messages to the app

In the context of the research described in this thesis, both front and the back end of the system have been developed. The front end includes the development of a website, Android based app, and the backend includes a database with user (activity) data and persuasive messages and integration of an off-the-shelf activity tracker (Fitbit), which automatically fetches data from sensors such as activity monitor and GPS.

In order to provide users the possibility to also view their information via a website, the main dashboard of the system has been developed as a web page. Within the app, the main component is a GUI element (i.e., a WebView component) that renders this web-based dashboard. Since a responsive web design (Bryant & Jones, 2012) approach was followed, the website automatically adapts to smaller screen sizes. For users, the use of a WebView component is therefore completely transparent. It behaves like a personalized app and a user does not need to login
separately via the WebView: once a user has created an account for the Active2Gether system in the Android system, the app uses those credentials to automatically log in the user and to show the appropriate page inside the WebView component. A drawback of the current choice was that integration with third-party API’s (i.e., Fitbit and Facebook authentication) was difficult; Fitbit does not allow to use their authentication API through the WebView. This can be solved with the newer Chrome tabs approach.

The other functions of the mobile phone app are to facilitate the communication with the user and to monitor the user’s location. The app connects every 15 minutes via a web service to the communication engine of the system. Messages or questions that are prepared for the user by the reasoning engine are collected and answers and read notifications are sent back. Whenever a new message or question is sent to a user, it appears in the status bar and when the user clicks on the message it is shown in the main screen.

The commercial Fitbit One was used as activity tracker that registers the daily amount of steps and the number of stairs climbed. All the recorded data is uploaded via a computer to the Fitbit server, Fitbit provides a web service which can be used to fetch the data from this server. In order to access this web service a user has to grant access to the Active2Gether system. After the first time login a user is asked to connect to his/her Fitbit account with the Active2Gether system. A connection is established through an open authentication mechanism (OAuth2 protocol). Once the connection is made, Fitbit provides credentials that allow to read the data of this user. They are stored in the database, so the Active2Gether system can directly access the Fitbit web service to receive activity data for a user and store it into the Active2Gether database. A script runs every hour to update the database with most recent activity data. Sometimes users forget to synchronize their Fitbit device or they forget to charge it; for those situations a script periodically checks whether a user’s battery level is low or the last sync time is three days old, and in that case a reminder is sent. The Fitbit app was used to synchronize the data with the activity tracker. This was necessary because it is not possible to read the Fitbit device directly. As a consequence, the Fitbit app or a computer was needed in addition to our own system. For future applications, direct communication between the coaching system and activity trackers is preferred.

The Active2Gether app uses the Google location services for recording the location in terms of GPS coordinates (latitude and longitude). As soon as a user logs in, he is asked to authorize the use of location tracking. It is possible for a user to turn off the location detection option, but this will disable certain features. We experimented with different time intervals as it turns out that the most optimal frequency in terms of battery consumption is five minutes. Every 15 minutes the
data on the mobile phone is synced with the server. A database table stores latitude, longitude, speed, accuracy and time stamp for each location.

A script runs every night to compute the clusters of locations that a person has visited. Clustering is performed using a density-based clustering algorithm. These results are stored as number of minutes at each of the locations. This duration information is used to find out whether people visited certain locations significantly. Since the user locations are provided in the descriptive form, geocoding is used to transform them into latitude and longitude numbers.

3 Implications and Future work

Future work and implications are discussed in the subsequent sub sections. Section 3.1 provides a possible future direction for advancing the current work by validating some of the models presented in this dissertation. It would be interesting to explore alternative modelling approaches and compare and contrast their pros and cons. Section 3.2 presents a brief account of such alternative modelling approaches. Implications of the current work includes (but not limited to) for example, people who are interested in the design and development of an e-coaching solution for a healthy lifestyle. Moreover, various computational models that were developed in this thesis can have implications on other human directed areas such as psychology, which is discussed briefly in Section 3.3. Finally, Section 3.4 describes possible extensions to the Active2Gether system.

3.1 Validation of the current models

Empirical validation of a computational model of a human process is important for at least two reasons: first it helps to understand to what extent a phenomenon such as a social or psychological is captured correctly and whether its practical applicability is acceptable, and second it further helps to identify what kind of parameter value captures a particular kind of personality type correctly. Each of the chapters (in this thesis) addresses the limitations with regard to that particular work. One of the limitations of the current work is related to validation of some of the models presented in this work. A computational model can be very complex and generic such as a cognitive architecture or it can be very specific and focus on one particular aspect of cognitive, emotional, or social aspect. A computational model with many details can be difficult to validate; in that case it is suggested to decrease the level of details (Sun, 2009). In this thesis, the presented models each focus on one particular aspect. For example, Part II of the thesis presents some models about emotion regulation in which specific aspects such as a reappraisal strategy (in Chapter 2) are modeled. Validation studies performed with empirical data are quite expensive and time consuming processes. Moreover, finding a good fit may not be a
trivial task, here parameter estimation methods can be used with care to achieve a good fit (and avoid overfitting). Nevertheless, an empirical study would greatly enhance our ability to understand cognition and utilize computational models more often in real life studies. The data for empirical studies can be obtained from a variety of sources for example it can be acquired through neuroscience methods such as FMRI, MRI or EEG. In addition, modern sensors and wearables are rather inexpensive and are easily available. Although it depends on a particular domain and problem (as mentioned in the introduction Chapter 1), various kinds of data can be obtained in order to perform a validation study; for example heart rate, skin conductance, brain activity, general activity tracking, and/or location monitoring can all be used for more thorough validations of the models.

The modelling approach adopted here is based on Network-Oriented Modelling (Treur, 2016b). The temporal-causal network models used are described at two levels: by a conceptual representation and by a numerical representation. A numerical representation can be analyzed mathematically and/or validated based on real life data by comparing simulation results with these data. A mathematical analysis would help increase the transparency and understanding of a model (McClelland, 2009). In Chapter 3, a mathematical analysis was performed to perform internal validation (sometimes referred as verification) that the model provides the correct results.

3.2 Role of Computational modeling

Regardless of a particular modelling approach, the computational models developed in the AI community gain interest by many people, for example in other human directed sciences such as psychology and cognitive science. They help to understand and visualize mental and social phenomena. An informal verbal description of a model often has ambiguities and vagueness, computational modeling helps to overcome these irregularities and enhances our understanding of the underlying phenomena; for further discussion see (Sun, 2008). Moreover, computational modeling can be considered a tool to build new theoretical knowledge; see (Sun, 2009) for a more thorough discussion. Computational modeling enables us to explore and understand human mental processes in profound ways which may not be possible with informal models. A rigorous approach is required, as simply by observation of human behavior or thought it may not be possible to understand human processes (Sun, 2008). Due to the advancements in neuroscience imaging techniques, our understanding about a human’s mental processes has deepened. It has led to the idea of creating computational models with many phenomena integrated into a single model (Sun, 2008). A model is a simplification of reality, a model with not too many details would help understand the complexities of a phenomenon in a better way (McClelland, 2009). Researchers
working in the areas of cognitive sciences are particularly interested in those computational models. But one of the concerns in the non-programmer community is that these models are not easy to be operated; simulation environments exist but they often are too complex to be used by non-programmers (Addyman & French, 2012). Perhaps there is a need for more user-friendly versions of simulation environments which facilitate non-programmers to experiment with these models by using their own data, modifying some parts of the model or just execute the model to observe the results (Addyman & French, 2012). Furthermore, computational modeling enables us to test new hypotheses and predict new knowledge and propose theories based on an emergent behavior.

3.3 Choices for modeling approaches

Besides Network-Oriented Modeling (Treur, 2016b), other modelling approaches also exist. As a future work, it would be interesting to consider what cognitive phenomena are preferably represented by which modelling approach, and what are the pros and cons of those approaches. Network-Oriented Modeling presents many advantages. For example, it provides an easy and intuitive way to model mental and social processes. Moreover, to capture the dynamics of mental and social processes a temporal dimension is included which is based on the concept of temporal-causal networks (Treur, 2016a). However, there are other ways to model such kind of processes as well, for example stochastic approaches can be employed (e.g., based on a Bayesian network approach). Furthermore, other modeling approaches includes symbolic representation such as described in (Marsella & Gratch, 2009). In this paper, researchers presented a computational model of emotion regulation based on the idea that emotions are generated based on an individual’s interpretation of the situation. In this approach the model is based on the combination of symbolic and numerical representations. A dynamic modeling approach is more general and therefore provides a wide array of possibilities to model different domains. The Network-Oriented Modelling approach is a hybrid approach which uses some of the flavors of connectionist approach and some features from dynamic modeling approaches (Van Gelder & Port, 1995). For example, from the dynamic approach we use time scale, differential equations and from the connectionist approach we use the ideas of networks like structures. But in connectionist approaches usually the concept of networks is different from the networks such as social networks (Bosse et al., 2011; Treur, 2016b). Furthermore, usually in a connectionist approach a fixed combination function is used, for example logistic function but in the dynamic approach there is no restriction and therefore any combination function can be used (Treur, 2016a).
3.4 Possible extensions to reasoning engine of Active2Gether system

The reasoning engine is one of the important components of the Active2Gether system. Its purpose is to assess the user’s activity and awareness level, suggest a coaching domain based on hypothesized room for improvement, and predict the most promising coaching determinants. The reasoning engine is based on a computational model which is the formalization of the “cognitive theory” (see Chapter 5). But this model may not cover all aspects needed in the system. For example, one of the aspects used in the system is to use a social network to enhance motivation and provide encouragement by means of the social phenomena. When employing a social network perhaps a model based on various social phenomena may be used or maybe different theories of different social phenomena can be tested to see which one is able to increase the motivation of participants. It was discussed in Part II that a social component can improve the outcome of a health promotion program. But the question what kind of social phenomena works under what circumstances requires further investigation. Perhaps one of the future directions is to employ a computational model based on different social phenomena such as contagion, homophile, social support, etc. Such a computational model would provide the opportunity to introduce new interventions (see Part II network interventions). For example, by giving knowledge about friendship networks of people it can help to predict or propose friend connections to a person who have a more active lifestyle. A social component based on the incorporation of such a computational model may help to achieve better physical activity levels.

The future directions presented above would improve the quality of support and the resulting system, and could thus better contribute to achieving a healthy lifestyle. The sketched future directions are the result of research conducted in this thesis. In this work we argued that to support or influence humans, it is required to study different mental processes. When this knowledge is embedded within modern technology, we believe that we can bring mobile support systems to its true potential.

References


