Opportunities for Smart & Tailored Activity Coaching

Harm op den Akker
Roessingh Research and Development
Telemedicine group
h.opdenakker@rrd.nl

Randy Klaassen
University of Twente
Human Media Interaction
r.klaassen@utwente.nl

Rieks op den Akker
University of Twente
Human Media Interaction
h.j.a.opdenakker@utwente.nl

Valerie M. Jones
University of Twente
Telemedicine group
v.m.jones@utwente.nl

Hermie J. Hermens
Roessingh Research and Development
Telemedicine group
h.hermens@rrd.nl

Abstract

This short paper describes how emerging technologies can be used to augment the effectivenes of activity coaching applications through tailoring.

1   Introduction

Technology aided coaching on healthy behavior is widely regarded as a promising paradigm to aid in the prevention of chronic diseases and the process of healthy ageing in general. In order to encourage physical activity in patients suffering from chronic disease, as well as healthy adults, many different coaching systems have been developed. Typically these consist of an activity sensor and some form of coaching application delivered either through a web portal, smartphone or the sensor itself. We present our model of tailoring as a framework for discussing key areas in which such activity coaching applications can be improved. Tailoring is the process whereby a system adjusts its communication to a specific user. We concretize this definition by considering four communication properties: *intention*, *timing*, *content*, and *representation*. In our case, a typical intention would be to either inform about the benefits of physical activity, or to provide information on the user's daily progress towards a goal. Timing defines the moment at which the system chooses to initiate an interaction. Content consists of the chosen words in a verbal communication, or values displayed in a graphical representation of progress. Given these four properties, the goal of tailoring is to increase the system's likelihood of conveying its *intention* by matching the *timing*, *content*, and *representation* to the user in his specific context. Based on the work by Hawkins et al. [2] and our own literature study [6], we identified six different forms of tailoring and matched them to the communication properties. In this model (Figure 1), **feedback** is used to present the user with information about himself. **Inter-human interaction** provides support for interaction with other real humans. **Adaptation** "*attempts to direct messages to individuals' status on key theoretical determinants...*" [2]. **User targeting** "*attempts to increase attention or motivation by conveying that the communication is designed specifically for you*" [2]. **Context awareness** is the notion of tailoring a communication based on external information. **Self learning** can be used to enhance other tailoring techniques through adapting to the user by learning from his reactions to previous communications.

2   Key Areas for Improvement

The model of tailoring presented is based on an analysis of the state of the art of tailoring in real-time activity coaching systems [6]. Combined with research into emerging smart technologies as well as our many years of experience in deploying physical activity coaching systems to various patient populations, we have identified opportunities for future research directions in six key areas related to activity coaching.

I. Smart Sensing. Use sensor data fusion to combine accelerometer data from the activity sensor and location data from the smartphone to provide accurate activity classification, increasing the accuracy of energy estimation algorithms and providing additional context to the virtual coach.

II. Adaptive Goal Setting. Employ activity data gathered from the user to learn a user-specific — challenging but achievable — goal, and define a balanced individual *pattern* that can prompt the user to increase his activity at times during the week and day where it is most suitable for him.

III. Adaptive Reminding. Find the opportune moment
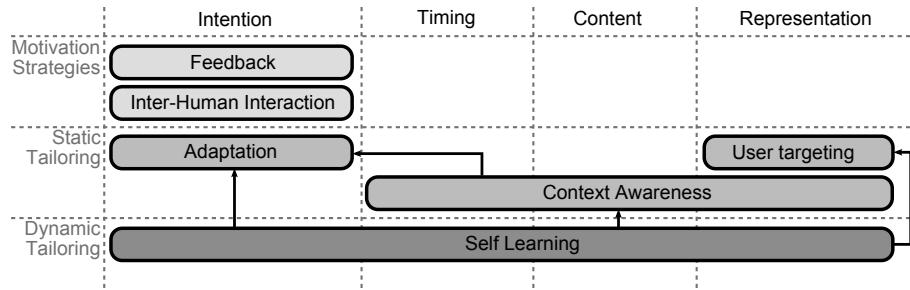
Figure 1. The relationships between tailoring techniques and the communication model properties. The layering describes how certain techniques can be used to augment others.

for motivational cues by analysing the user's response to those messages in relationship to current contextual factors, increasing the possibility of favourable response while reducing the risk of information overload and interruption irritability [3]. The proof of this self-learning approach is given in [5].

IV. Personalized Message Generation. Motivational messages can be tailored to psychological constructs (adaptation) or the user's environment (context awareness) and preferences. Natural language generation techniques can be used to generate varying and relevant messages.

V. Advanced HCI. To increase perceived intelligence of a smart coaching system, embodied (conversational) agents offer an interesting opportunity as HCI-paradigm. As Bickmore et al. showed [1], ECAs can have a positive effect on perceived relationship with a software agent.

VI. Pervasive Coaching. As humans interact with many different devices during the day, cross media systems offer the opportunity for the activity coach to travel with the user across those devices. Depending on the needs and context of the user, coaching can thus be provided on the most suitable device (e.g. smartphone, PC, smart television) [4].

3 Conclusions

We have identified six areas where smart technologies can be applied to tailor various aspects of an individualised activity coach. Location-aware activity-type sensing (I) and self-learning individual goal setting algorithms (II) should form the basis for providing awareness of physical activity as well as obtainable goals. The generation of motivational messages can benefit from complex pattern analysis to determine an optimal timing (III) and content (IV) of messages for the user in his current context. Language generation tools can alleviate the problem of repetitiveness in natural language interaction between user and coach. The presentation of an intelligent coach can use advanced HCI methods — e.g. the use of ECA's (V) — that can migrate

with the user through various devices in order to optimally use the available interaction resources at the user's current location (VI). Based on our analysis we formulated a model for smart tailoring of feedback and attempted to improve coaching strategies. In different experiments we developed and implemented technologies that aim to find an optimal timing for motivational messages [5], systems for context-aware message generation and intelligent embodied agents which travel with the user across multiple devices [4]. From own experience, as well as the state of art [6], we see future research directions in the use of more advanced context sensing and the application of machine learning technologies as the way towards an autonomous, adaptive and individualised coaching agent.

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