

Special issue on supporting a healthier lifestyle with e-coaching systems

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Already in the mid-1960s of the twentieth century, the German-American computer scientist Joseph Weizenbaum implemented a program that mimicked a virtual Rogerian psychoanalyst called “Eliza” [1]. Eliza analyzed natural language statements, typed by the user, and then generated a response. The program did not “understand” the user’s statement in terms of natural language semantics, but inspected it for the presence of keywords and used a rule to transform the keywords into a response. Weizenbaum showed that a digital therapist could be implemented in a computer system that has strong positive emotional effects with relative simple means.

Since the appearance of Eliza, both the digital and the medical world have changed radically. Formal languages to control computers have given way to graphical user interfaces that enable the majority of the world’s population to interact with computer systems. The internet and powerful mobile technology continuously unite computers and people all around the globe. Nowadays, computer systems support a wide range of users with complex mental tasks, such as decision-making and simulation of virtual worlds in various domains; they represent social agents that give advice, play games, and even beat human players in Jeopardy, the world’s most prestigious intelligence quiz [2]. In health care, there is a growing awareness that psychology, personalization, and coaching play a crucial rule in prevention and behavior change [3, 4]. Healthy behaviors—such as eating healthy food, performing daily physical activity, reducing stress, and regularly getting enough sleep—all have a positive impact on our health, but changing habits towards healthy behavior is often strenuous for a myriad of reasons. Health promotions, self-help books, and websites try to persuade and support individuals to adopt healthy lifestyles and eschew unhealthy habits. But an important problem is that these channels are targeted at large groups and do not take people’s individual characteristics into account.

In parallel with these technological and health care developments, a new field of interaction technology has emerged: based on motivation and behavior models from psychology and social sciences, so-called *persuasive technology* was introduced to support users in changing attitudes, thinking, and behavior through technology that uses persuasion and social influence [5]. Relatedly, a new terminology in interaction technology was adopted: not only are computer systems user-friendly, they must be cooperative, trustful, and able to build a relationship with users [6, 7]. In other words, emerging technology enables us to implement personalized, cooperative, and empathetic mobile agents (not only artificial social

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agents but also nonsocial agents) that provide a basis for integrating coaching principles in smartphones that go far beyond the capabilities of Weizenbaum's Eliza.

In the field of consumer health care, health supporting systems have continued to advance in response to these rapid changes. Engineering and research efforts resulted in a variety of technological products, ranging from various types of monitoring systems to self-help apps that aim to change an individual's behavior and cognition. Today, over 100,000 health apps exist in Apple's App Store and in Google Play, supporting all types of health-related activities. A major problem is that consumer health care applications have proliferated without regard for their effectiveness and real user needs [8]. Moreover, the majority of these applications are hardly ever based on scientific theories and insights. There is thus an urgent need for a shift to a design process that incorporates careful analysis and evaluation of the persuasive techniques and coaching processes intended to support changes in health behaviors.

The current special issue aims to showcase research addressing various aspects relevant to "e-coaching" applications that support people in adopting or maintaining a healthy lifestyle. A healthy lifestyle is reflected, for example, in sufficient physical activity, sufficient sleep, healthy eating patterns, effective stress-coping skills, and mental well-being in general. E-coaches can be powerfully influential and have several important advantages over existing communication channels and techniques. First, the use of mobile technology permits the assessment of relevant momentary information and the delivery of fully automated feedback in the appropriate form and modality, at the appropriate time and location. Second, the existing technology enables tailored support on the basis of both personalized and environmental information of the individual user. Third, non-obtrusive sensory measurement enables the collection of objective data that can be integrated in the intervention. Fourth, current communication platforms and infrastructures facilitate information exchange between various user groups, such as peers, human therapists, and coaches. In addition, e-coaching systems have the potential to improve cost-efficiency, provide lifelong support to users, and relieve the current health care system of a wide range of burdens. All this highlights the need for insights into the psychology of e-coaching, as well as the dynamics of human-computer interactions. Situated at the crossroads of research on health psychology, human-computer interaction, artificial intelligence, and ethics, this research area is of importance both to understanding fundamental scientific issues of behavior change through technological systems and to developing innovations that are urgently needed in society.

This special issue covers various health domains and topics such as data analysis, interaction technology, feedback strategies, and the role of person-to-person communication in the e-coaching process. The first paper (by Kamphorst) "e-Coaching

Systems, What They Are and What They Aren't" focuses on developing a precise definition of e-coaching. In his paper, e-coaching systems are considered to be artificial entities that can observe, analyze, and predict a user's behavior and that promote effective goal striving through the use of behavior change techniques. A minimal set of features is proposed, ranging from the system's ability to establish a collaborative relationship to the ability to guide its user in a planning process.

The second paper (by Mollee, Middelweerd, Kurvers, and Klein) "What Technological Features are Used in Smartphone Apps that Promote Physical Activity? A Review and Content Analysis" investigates the current landscape of smartphone apps that promote physical activity for healthy adults. They present a framework to rate the extent to which such apps incorporate technical features, such as measurement, support, and adaptation. In total, 227 physical activity apps were selected for analysis. They conclude that developers of such apps are not taking full advantage of the possibilities of current smartphone technology, and that there is ample room to include more intelligent physical activity promotion interventions.

In the third paper (by Spanakis, Weiss, Boh, Lemmens, and Roefs) "Machine Learning Techniques in Eating Behavior e-Coaching: Balancing between Generalization and Personalization," classification and clustering techniques are presented to exploit data collected from a mobile app. The app, called "ThinkSlim", assesses an individual's eating behavior, emotional status, level of craving, social status, and cognitions related to eating by using experience sampling methods (ESM). Based on these data, algorithms were developed that allowed semi-tailoring an intervention. More specifically, rules were extracted that predicted unhealthy eating behavior at time t from measured variables measured at time $t-1$. Part of ThinkSlim consisted of semi-tailored intervention right at the moment when it was relevant, that is, when an unhealthy eating event was about to occur.

In the fourth paper (by Beun, Fitrianie, Griffioen-Both, Spruit, Horsch, Lancee, and Brinkman) "Talk and Tools: The Best of Both Worlds in Mobile User Interfaces for E-Coaching," a user interface paradigm is presented for automated e-coaching. The paradigm integrates two types of interaction: personalized dialogues that mimic the conversational behavior of a coach ("Talk") and specialized modules that support particular tasks within the coaching domain, such as monitoring and data presentation ("Tools"). The paradigm was applied in the domain of sleep-restriction insomnia therapy and implemented in a system called "SleepCare". It is concluded that the addition of a conversational component fills an important gap in the design of current mobile systems, in particular those systems that offer an automated coaching program over a longer period of time.

In the fifth paper (by de Vries, Truong, Zaga, Li, and Evers) "A Word of Advice: How to Tailor Motivational Text Messages Based on Behavior Change Theory to Personality

and Gender,” personal preferences for motivational strategies were studied. Motivational text messages were coded in ten categories (consciousness raising, dramatic relief, etc.) and subsequently evaluated in a cross-sectional survey/study to see how the messages would be rated on motivation or demotivation. It was found that personality and gender influence how motivating behavior change strategies are perceived and, therefore, should be incorporated in the design of e-coaching systems.

In the sixth and seventh paper, the role of one or more human participants as a supporting coach is investigated. In the paper (by Boratto, Carta, Mulas, and Pilloni) “An E-Coaching Ecosystem: Design and Effectiveness Analysis of the Engagement of Remote Coaching on Athletes,” a commercial e-coaching system designed for runners is described and evaluated. In their study, the effectiveness of the support offered by a qualified human coach compared to a virtual coach is investigated. The results show that users are more engaged and more adhered to the program when the training is developed and supervised remotely by a human coach. It is concluded that the inclusion of human professionals significantly improves the effectiveness of the program and that, given the limits of current technology, an e-coaching protocol cannot entirely be automated, but should be based on human interaction to improve motivation and user adherence.

In contrast to the expert role of the coach in the previous paper, the seventh and final paper (by Tikka and Oinas-Kukkonen) “Contributing or Receiving: The Role of Social Interaction Styles in Persuasion over a Social Networking Platform” discusses the role of peer support as a coaching strategy. In this study, two basic behavior roles on Twitter are compared (the active contributor vs. the passive recipient) and the role of the need for cognition in message elaboration and behavior change is investigated. It was found that taking an active content, creating role in peer-to-peer e-coaching systems may lead (a) to higher efficacy appraisal without a positive impact on behavior change and (b) to reduced attention on the intended behavior change message. The authors concluded that there is a need for investigating strategies overcoming the distracting nature of an active sharing role in e-coaching systems presented by a social network platform.

With this set of papers, we hope to contribute significantly to a scientific approach to e-coaching for healthy lifestyles. We sincerely believe such a scientific approach is needed in this growing field, as part of the identification and validation of valuable components in effective strategies for promoting healthier behaviors. We therefore would like to thank Peter Thomas, the Editor-in-Chief of Personal and Ubiquitous Computing, for giving us the opportunity to promote the challenging topic of e-coaching for a healthier lifestyle. Many thanks also to the following reviewers: René Ahn, Jeroen Benjamins, Martin van Boxtel, Matthieu Brinkhuis, Willem-Paul Brinkman, Egon van den Broek, Harry Bunt, Fiemke Griffioen-Both, Aart van Halteren, Wilhelm Hofmann, Joost Hutsebaut, Jaap Lancee, Saskia Kelders, Joyca Lacroix, Judith Masthoff, Sanne Nauts, Philip Nickel, Marieke Peeters, Maartje Poelman, Boris de Ruyter, Karin Slegers, Eline Smit, Sigrid Stjernswärd, Lieve Temmerman, Saskia te Velde, and Arlette van Wissen.

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